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# AIR POLLUTION ABSTRACTS

## 33522 - 34197

MARCH 1974

U.S. ENVIRONMENTAL PROTECTION AGENCY
Assistant Administrator for Air and Water Programs
Office of Air Quality Planning and Standards
Control Programs Development Division
Research Triangle Park, N. C. 27711

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This periodical is published to inform air pollution personnel of the Environmental Protection Agency (EPA), and others, of technical literature recently accessioned by the Air Pollution Technical Information Center (APTIC). For each accession, its Abstract Number, APTIC accession number, bibliographic citation, and abstract are given. Translations are cited with their sources whenever possible. The subject fields are as follow: Emission Sources; Control Methods; Measurement Methods; Air Quality Measurements; Atmospheric Interactions; Basic Science and Technology; Effects-Human Health; Effects-Plants and Livestock; Effects-Materials; Economic Aspects; Standards and Criteria; Legal and Administrative; Social Aspects; and General and Miscellaneous. All abstracts are listed under one of the above subject fields. A subject and author index are included. This issue contains abstracts 33522 - 34197.

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# AIR POLLUTION ABSTRACTS

VOLUME 5, NO. 3 MARCH 1974

Prepared by
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Author Index .......... AI-1
Personal authors are arranged alphabetically. The names are presented last name first. When the author is a primary author, an asterisk precedes the Abstract Number.

# INTRODUCTION

This periodical is intended to inform personnel of the Environmental Protection Agency (EPA), and others who are also professionally interested in air pollution, of selected technical literature recently accessioned by the Air Pollution Technical Information Center (APTIC). For each accession, its Abstract Number, APTIC accession number, bibliographic citation, and abstract are given.

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The serial publications (journals, periodicals, etc.) being scanned number approximately 7,000. A list of approximately 1,000 of the most productive publications with the address of each publisher is available upon request.

As another service, abstracts of all of the literature in APTIC (not just in a single issue of this periodical) on any subject related to air pollution will be provided free of charge upon request. APTIC can search information more recent than that in the current issue of this periodical because of the lapse of time entailed by editorial, make-up, and printing work.

More than 1400 subject index terms are available for such searching ---more than those included in the subject index in each issue.

Acknowledgement is given to the Technical Publications Branch, Informational Services Division, Office of Administration, Research Triangle Park, N.C. for the make-up of the cover and for arrangement of printing and distribution.

Feedback from our users, including suggestions of articles, are always welcome.

# APTIC Publications

*Air Pollution Aspects of Emission Sources: Primary Lead Production - A Bibliography with Abstracts*, June 1973, GPO No. EP 4.9:126, $0.65.

*Air pollution Aspects of Emission Sources: Primary Copper Production - A Bibliography with Abstracts*, June 1973 GPO No. EP 4.9:125, $0.70.

*Air Pollution Aspects of Emission Sources: Pulp and Paper Industry - A Bibliography with Abstracts*, March 1973, GPO No. EP 4.9:121, $2.35.

*Air Pollution Aspects of Emission Sources: Primary Aluminum Production - A Bibliography with Abstracts*, June 1973, GPO No. EP 4.9:119, $0.90.

*Mercury and Air Pollution: A Bibliography with Abstracts*, October 1972, GPO No. EP 4.9:114, $1.25.

*Odors and Air Pollution: A Bibliography with Abstracts*, October 1972, GPO No. EP 4.9:113, $3.00.

*Air Pollution Aspects of Emission Sources: Petroleum Refineries - A Bibliography With Abstracts*, July 1972, GPO No. EP 4.9:110, $1.25.

*Air Pollution Aspects of Emission Sources: Iron and Steel Mills - A Bibliography With Abstracts*, May 1972, GPO No. EP 4.9:107, $1.00.

*Air Pollution Aspects of Emission Sources: Boilers - A Bibliography With Abstracts*, May 1972, GPO No. EP 4.9:105, $2.00.

*Hydrochloric Acid and Air Pollution: An Annotated Bibliography*, July 1971, GPO No. EP 4.9:100, $0.55.

*Chlorine and Air Pollution: An Annotated Bibliography*, July 1971, GPO No. EP 4.9:99, $0.55.

*Air Pollution Aspects of Emission Sources: Electric Power Production - A Bibliography With Abstracts*, May 1971, GPO No. EP 4.9:96, $2.25.

*Air Pollution Aspects of Emission Sources: Cement Manufacturing - A Bibliography With Abstracts*, May 1971, GPO No. EP 4.9:95, $0.50.

*Air Pollution Aspects of Emission Sources: Sulfuric Acid Manufacturing - A Bibliography With Abstracts*, May 1971, GPO No. EP 4.9:94, $0.65.

*Air Pollution Aspects of Emission Sources: Nitric Acid Manufacturing - A Bibliography With Abstracts*, May 1971, GPO No. EP 4.9:93, $0.45.

*Air Pollution Aspects of Emission Sources: Municipal Incineration - A Bibliography With Abstracts*, May 1971, GPO No. EP 4.9:92, $1.00.

*Photochemical Oxidants and Air Pollution: An Annotated Bibliography (2 Volumes)*, March 1971, GPO No. EP 4.9:88, $6.25.

*Beryllium and Air Pollution: An Annotated Bibliography*, February 1971, GPO No. EP 4.9:83, $0.40.

*Asbestos and Air Pollution: An Annotated Bibliography*, February 1971, GPO No. EP 4.9:82, $0.50.

*Municipal Incineration: A Review of Literature*, June 1971, GPO No. EP 4.9:79, $1.00.

*Hydrocarbons and Air Pollution: An Annotated Bibliography (2 Volumes)*, October 1970, GPO No. HE 20.1309:75, $5.00.

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# RECENT CONTRACT AWARDS

from the

## Durham Contract Operations
## Contracts Management Division, EPA

**Contract No. 68-02-1273,** RFP No. Du-74-B375 .................................................. *$138,900*

DETERMINATION OF NO-EFFECT LEVELS OF PARTICLE GROUP COMPOUNDS AND BASE METAL COMPOUNDS USING MOUSE INFECTIVITY MODEL.

IIT Research Institute, 10 West 35th Street, Chicago Illinois 60616

**Contract No. 68-02-1388,** RFP No. DU-74-A107 .................................................. *$40,000*

PREPARE GUIDELINES ON THE ANALYSIS OF LAND USE AND TRANSPORTATION

Alan M. VoorHees and Associates, Inc., Westgate Research Park, McLean, Virginia 22101

**Contract No. 68-02-0631,** RFP No. DU-73-A270 .................................................. *$120,602*

CONTINUING THE STUDY OF LIMESTONE WET SCRUBBING OF SO2 IN A RESEARCH MODEL PILOT SCRUBBER

Monsanto Research Corporation, Dayton Laboratory 1515 Nicholas Road, Dayton, Ohio 45407

**Contract No. 68-02-0768** RFP No. DU-74-B423 .................................................. *$70,800*

STATIONARY AND MOBILE FACILITIES FOR STUDY OF HEALTH EFFECTS OF ENVIRONMENTAL CONTAMINANTS

Computer Sciences Corporation, 6565 Arlington Boulevard, Falls Church, Virginia 22046

**Contract No. 68-02-1393** RFP No. DU-73-A062 .................................................. *$151,116*

MEASUREMENT TECHNIQUES FOR INORGANIC TRACE MATERIALS IN CONTROL SYSTEMS STREAMS

TRW Systems Group, TRW Inc., One Space Park, Redondo Beach, California 90278

**Contract No. 68-02-1001,** RFP No. DU-73-A256 .................................................. *$28,848*

ESTABLISHMENT OF NON-EPA USER SYSTEM FOR STATE IMPLEMENTATION PLANS

PEDCo Environmental Specialists, Inc., Suite 13 - Atkinson Square, Cincinnati, Ohio

**Contract No. 68-02-1593** RFP No. DU-74-C767 .................................................. *$36,728*

HEATING FUEL OIL

Metro Oil Company, Box 526, Paw Creek, North Carolina 28130

**Contract No. 68-02-0626,** RFP No. Du-74-A029 .................................................. *$98,254*

EVALUATION AND COLLABORATIVE TESTING OF METHODS RECOMMENDED FOR MEASUREMENT OF STATIONARY SOURCE EMISSIONS

Southwest Research Institute, 3600 South Yoakum Boulevard, Houston, Texas 77006

| | |
|---|---|
| **Contract No. 68-02-1387,** RFP No. DU-74-A105 | *$38,000* |

SO2 DIFFUSION MODEL FOR SELECTED AREAS IN ALLEGHENY COUNTY, PENNSYLVANIA

H. E. Cramer Company, Inc., P. O. Box 9249, Salt Lake City, Utah 84109

| | |
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| **Contract No. 68-02-1385,** RFP No. DU-74-A062 | *$30,000* |

EMISSION INVENTORY AND TRANSPORTATION CONTROL PLAN DEVELOPMENT FOR CLARK COUNTY, NEVADA (LAS VEGAS)

TRW, Inc., 7600 Colshire Drive, McLean, Virginia 22101

| | |
|---|---|
| **Contract No. 68-02-1392,** Order No. 1, RFP No U-74-A007 | *$35,520* |

PREPARATION OF A GUIDELINE DOCUMENT FOR EVALUATING SUPPLEMENTARY CONTROL SYSTEMS

H. E. Cramer Co. Inc., P. O. Box 9249, Salt Lake City, Utah 84109

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| **Contract No. 68-02-0293,** RFP No. DU-74-A017 | *$72,923* |

DEMETALLIZATION OF RESIDUAL OILS

Hydrocarbon Research, Inc., New York & Puritan Avenues, Trenton, New Jersey 08638

# SUBJECT FIELDS AND SCOPE NOTES

## 1. EMISSION SOURCES

Information pertaining to an industry, process, or material associated with air pollution. Documents in this category are concerned primarily with characteristics of a specific class of emission sources including types, rates, industries; secondary coverage may include effects, control methods, etc.

## 2. CONTROL METHODS

Includes equipment and both specific source control and general abatement efforts. Included are documents describing the operating principles, design, operation, efficiency, etc., of equipment and methods of removing pollutants. The scope of the document can vary from a device for a specific source to an approach applicable to an entire industry--e.g., automobiles.

## 3. MEASUREMENT METHODS

Includes equipment as well as methods. Confined to development testing and evaluation of pollutant determination methods (sampling, analytical, monitoring) and equipment, as such. Data obtained by use of methods in specific applications are placed in the applicable subject categories.

## 4. AIR QUALITY MEASUREMENTS

Pollution measurements in the ambient air, generally related to specific geographical locations, such as area surveys. Also includes general reviews of area situations and emission source inventories.

## 5. ATMOSPHERIC INTERACTION

All chemical and physical phenomena occurring in the atmosphere Included is material on dispersion, air pollution forecasts, meteorological effects, topographical effects, photochemical reactions in the atmosphere, etc. Laboratory studies of photochemical reactions are assigned to Basic Science and Technology.

## 6. BASIC SCIENCE AND TECHNOLOGY

General discussions or data compilations for the basic physical and chemical properties of pollutants. Theoretical and laboratory studies on related chemical and biological reactions and mechanisms. Mass transfer and other basic knowledge related to process engineering applications in emission control or abatement. Excludes photochemical studies in the atmosphere and biochemical studies related to effects of air pollution.

## 7. EFFECTS--HUMAN HEALTH

Covers medical and epidemiological studies; biological effects other than those on plants and livestock produced by air pollutants; laboratory animal experiments.

### 8. EFFECTS--PLANTS AND LIVESTOCK

Effects on vegetation--crops, trees, other plants--and on livestock as distinguished from laboratory experimental animals.

### 9. EFFECTS--MATERIALS

Deterioration, corrosion, etc., of physical materials, buildings, and structures.

### 10. ECONOMIC ASPECTS

Economic implications of air pollution and its control, e.g., economic losses from pollution damage, and costs of control programs or equipment in general.

### 11. STANDARDS AND CRITERIA

Recommended or adopted guides, criteria and standards for allowable emission limits or pollutant concentrations, air quality, equipment characteristics, and fuels.

### 12. LEGAL AND ADMINISTRATIVE

Legal aspects include legislation, ordinances, rules, litigation, hearings, decisions, etc. Administration covers administrative and miscellaneous information concerning control agencies and control and research programs. Typical topics are personnel, budgets, contractual activities and program descriptions.

### 13. SOCIAL ASPECTS

Sociological and psychological aspects such as social attitudes public opinion studies, public relations, and public information.

### 14. GENERAL AND MISCELLANEOUS

Reviews of general problems, trends and background. Documents not assignable to other categories.

# ABSTRACT BULLETIN

## EMISSION SOURCES

### 1973

**33522** **APTIC NO. 56770**

Arceivala, Sorab J.

A REVIEW OF ENVIRONMENTAL POLLUTION STUDIES IN TURKEY. *Preprint. Middle East Technical Univ., Ankara (Turkey), Environmental Engineering Dept., 74p., June 1973. 46 refs.*

A review is presented on the current environmental pollution situation in Turkey. Only 11 industries can be considered significant point sources of air pollution in Ankara (emitting more than 100 tons per year of sulfur dioxide and particulates), and an inventory of emissions from different sources indicates that the major source of pollution is household heating. Pollution from vehicular traffic and industries is small in comparison. The range of SO2 concentrations within the city is 100-500 micrograms/cu m, while particulates range as high as 426 micrograms/cu m. Benzo(a)pyrene has been found in the air in concentrations ranging from 0.01-100 micrograms/1000 cu m. Results of a mathematical model for forecasting air quality indicate that by 1990 pollution will increase nearly fourfold if no control action is taken. If all fuels contain a maximum of 1% sulfur by 1980, however, the model predicts SO2 concentrations will about equal present readings, despite the increased emissions. Istanbul has a relatively minor air pollution problem although the gross emissions are more than in Ankara; this is due to regular sea breezes which dilute and carry away pollutants. Izmir is likewise favored with breezes. Pockets of air pollution have been reported to exist in other parts of Turkey such as Eskisehir and Kayseri, as well as some some small towns on the Anatolian plateau where meteorological conditions are often unfavorable. The major source of air pollution in Istanbul is the combustion of fuel for domestic and industrial heating and energy.

**33523** **APTIC NO. 56578**

Berlinsky, Elaine C., Anne P. Carter, and Melvin W. First

NATIONAL PRODUCTION, EMISSIONS CONTROL AND LOCAL AIR POLLUTION IN THE INTEGRATED IRON AND STEEL INDUSTRY: AN INPUT-OUTPUT MODEL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D50-D53. 25 refs.*

Results are presented from an investigation of the interrelationships between national production in the integrated iron and steel industry, air pollution controls, and local air quality via a three-compartment, national, input- output model. The study shows that for 1970 Final Demand, the addition of air pollution control devices throughout the integrated iron and steel industry will have little effect on the national economy but will have salutory effects on the local air quality. A change to the projected 1980 process mix will further reduce national emissions levels and local levels in counties where open hearth steel will no longer be produced. However, a change to 1980 Final Demand will negate any improvements attained by the addition of control devices and change of process mix under 1970 Final Demand because of the projected increases in total iron and steel production at most manufacturing locations. The largest contributor to praticulate air pollution from the iron and steel industry, coke production, is presently uncontrollable. Controls, however, are currently under development and may be available for this process by 1980. Data are included for distribution of particulate emissions by process and by county for 1970 and 1980. (Author conclusions modified)

**33524** **APTIC NO. 56522**

Chamberlain, Clive T., David F. Cooke, and Guy S. Coulson

ATMOSPHERIC EMISSIONS FROM INCINERATORS AND THEIR CONTROL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E91-E93. 10 refs.*

Incinerator pollutants, methods for their measurement and control, and standards of emissions are reviewed. Two classes of waste materials are defined: those producing little pollution such as hospital waste, municipality waste, sewage sludge, office waste, automobile tires, non-chlorinated plastics, and non-toxic solvents and those producing heavy pollution such as chlorinated plastics, metal recovery, toxic solvents, asbestos-containing wastes, acid tars and residues, and nitrogen-containing wastes. Those components which potentially always exist in incinerator emissions are: particulate matter and carbon monoxide. Precision of particulate measurement relies entirely upon the sampling procedure, and variations in measurement demand that no single test should be taken as pass or fail. Measurement of gaseous pollutants can be achieved without difficulty by infrared or chemical absorption; some of the wet chemical methods give doubtful results unless spectrographic or colorimetric methods are used. Particulate emission standards for a number of European countries and the United States are listed, and total costs for cleaning 100,000 cu m/hr of incinerator gas (inlet temperature of 350 C and particulate loading of 1500 mg/N cu m) are compared for high efficiency cyclone, wet impingement scrubber, electrostatic precipitator, and venturi scrubber.

**33525** **APTIC NO. 56848**

Davids, Peter, Kurt Gerhards, and Werner Brocke

RESULTS OF EMISSION MEASUREMENTS ON WASTE INCINERATOR PLANTS, AND TECHNICAL POSSIBILITIES OF EMISSION CONTROL. *(Ergebnisse von Emissionsmessungen an Muellverbrennungsanlagen und technische Moeglichkeiten zur Emissionsverminderung). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E94-E97.*

Results of emission measurements performed on six communal waste incinerator plants in West Germany are described. Cumulation of zinc and lead in the residual dust after electrostatic precipitation was observed. Such dust contained up to 5.3% zinc and less than 1% lead. With incinerator furnaces operated at a minimum temperature of 800 C, and oxygen contents of 6 to 16% in the combustion air, the carbon monoxide and unburned hydrocarbon concentrations can be limited to 200 ppm, and to 100 mg/N cu m, respectively. Balance calculations revealed that 92% of the total chlorine content, 12% of the total fluorine content, and 47% of the total sulfur content in solid waste are emitted in the form of hydrochloric acid, hydrofluoric acid, and sulfur dioxide, respectively. Formation of molecular chlorine and phosgene was not observed. Nitrogen oxides, formed from nitrogen-containing wastes and air nitrogen, were found in considerable quantities first at temperatures over 1600 C. The SO2 emissions were highest during

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the heating season due to the high percentage in the wastes of high-sulfur domestic ashes. The HCl and HF emissions increased during the last few years, without showing seasonal variations. The polyvinyl chloride wastes were responsible for 51% of the total HCl emission. Incinerator-generated emissions can be abated by scrubbing and by adsorption on additives. Scrubbers have efficiencies of 95-96% for HCl and HF. Incinerator slags were suitable for the adsorption of HCl, HF, and SO2 from incinerator waste gases due to their alkali-earth and alkali-metal contents.

**33526 APTIC NO. 56606**

Friedlander, S. K.

RELATING PARTICULATE POLLUTION TO SOURCES: CASE OF THE LOS ANGELES AEROSOL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C78-C80. 11 refs.*

A mathematical method and instrumental package for relating the physical and chemical characteristics of an aerosol measured at a given location over a period of time to the known characteristics of major industrial and natural sources are described. The fundamental equations are applied as follows: concentrations of the individual sources are estimated by a chemical element balance; size distribution emitted by each source is modified numerically using a suitable growth law until the amount of secondary material added is equal to that measured experimentally; the calculated size spectrum is checked against the experimentally measured spectrum; the calculated distribution of chemical elements with respect to size is checked against the experimentally measured distributions; and the calculated light scattering is checked against the experimentally measured value. The instrument package includes: a total filter to collect material for total msss and chemical analysis; a fractionating device to collect material according to size for chemical analysis; particle size analyzers to provide a detailed breakdown on particle size distribution; and an instrument which measures total light scattering to characterize visibility-related parameters. Los Angeles area data generated by the method are presented for source contributions to Pasadena Aerosol for the day 9/3/69 and concentrations of elements in particulate largely of secondary origins collected in Pomona, California over the 1200-1400 period on 10/24/72.

**33527 APTIC NO. 56847**

Garibaldi, P. and S. Facchetti

LEAD AS A POLLUTANT. PART 1: DATA ON ATMOSPHERIC LEAD LEVELS IN VARIOUS INDUSTRIALIZED COUNTRIES. *(Il piombo quale inquinante I. Rassegna dei livelli di contaminazione ambientale in diversi paesi industriali). Text in Italian. Rivista Combust. (Milan), 26(6):322-335, June 1973. 120 refs.*

The harmful effects of lead in the atmosphere, in water, in soil and vegetables, and in food are summarized, based on a review of previous experiments done in industrialized countries. Various data from pollution control work on Pb point to a continued annual increase of more than 5% in an urban environment are presented. A precise granulometric determination of atmospheric particles is also important since Pb absorption by the respiratory system is according to size. Experiments in the USA cities indicate an equal granulometric size of Pb particles in urban and non-urban zones with a mean diameter of 0.12 to 0.31 micron. The organic Pb in the atmosphere has not been deeply studied. Lead emitted in gas fumes contains chlorines and bromides which lose the halogen in contact with air. Studies in Europe of drinking water point to the influence of the pH of water from old piping and soil minerals. Water rich in carbonic anhydrides, carbon dioxide, or organic substances and nitrates has a solvent power for Pb. Soil water itself contains between 0.1 and 0.5 mg Pb/l. Lead in the soil or crops tends to augment with the nearness to traffic and can be absorbed via leaves and roots. It also tends to accumulate in moss. Analyses of various foods show an average Pb concentration of 1.0 mg/g with foods grown nearer highways and foods left exposed by sellers in cities with dense traffic having higher concentrations. On the whole, data from Pb research is insufficient and more coordinated efforts are needed.

**33528 APTIC NO. 56483**

Gilbert, Traugott

EMISSION LIMITS AND MEASURED EMISSIONS - A COMPARISON. THE REQUIREMENTS ARE NOT ALWAYS MET. *(Emissionsbegrenzungen und Emissionsmesswerte - ein Vergleich. Auflagen werden nicht immer erfuellt). Text in German. Umwelt (Duesseldorf), 3(6):32-36, 1973. 3 refs.*

Since emission limits without regular inspections make little sense, regular inspections of firing systems at 5-year intervals have been introduced. An expansion of the inspections to include other emission sources as well ans shorter interval inspections must be expected for the future. Continuous inspections through continuous recording of emission concentrations will gain increasing importance. Results of first inspections of firing systems are discussed. For example, for the oxides of nitrogen concentrations between 0.4 and 2.5 g/cu m of nitrogen dioxide were measured. Maintenance of the emission limits did not cause any trouble. For firing systems operated with heavy fuel oil, the particulate emission is presently limited to 70 mg/cu m during normal operation and to 200 mg/cu m during soot blowing; the average per kg fuel oil over the entire operating period is 1.5 g. The concentrations are based on a carbon dioxide concentration in the waste gas of 14%. Measurements at eight steam boilers with capacities between 5 and 10 t/hr and at one 80 t/hr boiler in 1972 showed that these requirements were mostly met. In 62% of the cases the measured values were lower than the respective limit value. The greatest difficulties in keeping the requirements were met in coal-fired boilers. Of 43 boilers with steam capacities between 25 and 500 t/hr and an emission limit for dust of 500 mg/cu m, 71.6% did not meet the requirement. Dust concentrations of up to 10 g/cu m were measured. Of 23 modern boilers, 43.5% did not meet the dust emission standard of 150 mg/cu m. All boilers were equipped with electrostatic precipitators.

**33529 APTIC NO. 56660**

Heywood, John B. and Thomas Mikus

PARAMETERS CONTROLLING NITRIC OXIDE EMISSIONS FROM GAS TURBINE COMBUSTORS. *Preprint. North Atlantic Treaty Organization, Aerospace Group for Aeronautical Research and Development, 15p., 1973. 30 refs. (Presented at the AGARD Propulsion and Energetics Panel, 41st Meeting on Atmospheric Pollution by Aircraft Engines, London, England, April 9-13, 1973.)*

The parameters controlling nitric oxide emissions from gas turbine combustors were investigated. Nitric oxide forms in the primary zone of gas turbine combustors where the burned gas composition is close to stoichiometric and gas temperatures are highest. Combustor air inlet conditions, mean primary zone fuel/air ratio, residence time, and the uniformity of the primary zone are the most important variables affecting nitric oxide emissions. Relatively simple models of the flow in a gas turbine combustor, coupled with a rate equation for nitric oxide formation via the Zeldovich mechanism correlate the variation in measured NOx emissions. Data from a number of different combustor concepts are analyzed and are in reasonable agreement with predictions. The model for predicting NO emissions can match measured emissions data from several different types of combustors over a wide range of operating conditions. The major problem in applying the model is that the parameter characterizing the fuel/air ratio nonuniformities must be determined empirically. The potential for relating this parameter to injection and combustor design and operating parameters has already been demonstrated in simpler flow geometries. (Author summary modified)

**33530** **APTIC NO. 56952**

Himi, Yasuji, Naoomi Yamaki, Issei Imagami, Kazuo Hishida, Tadao Shirasawa, Yoshimatsu Otate, Etsuo Yoneyama, Masanobu Nagata, Hitoshi Ishida, Ikuo Kobayashi, Keiji Kato, and Kazufumi Tachibana

ATMOSPHERIC EMISSION OF NOX AND HC FROM INDUSTRIAL FURNACE. *(Kogyoyo kotei nensho shisetsu ni okeru chisso sankabutsu, tanka suiso no haishutsu). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):320, Oct. 1973. (Presented at the Japan Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 66.)*

Nitrogen oxides and hydrocarbons emitted from fixed industrial sources were investigated with regard to five thermal power plants, six glass furnaces, one steel heating furnace, two blast furnaces, two coke furnaces, one cement baking furnace, one lime drying furnace, two cupolas, one iron ore sintering furnace, and one steel converter. The measurements were taken by chemiluminescence and flame ionization detector. Carbon dioxide, oxygen concentration, flue gas quantity, fuel consumption, burner types, flame temperature, combustion chamber temperatures, combustion chamber heat loads, and load fluctuations were examined. Nitrogen oxides emission quantity showed complex influences of flame temperature, combustion load, fuel composition and quantity, and the atomization method of burners; but the general rule of the higher flame temperature, the higher the NOx emission was proved true. The relationship between fuel composition and consumption with NOx emissions agreed with the Woolrich theory. With regard to burner atomization types, NOx emission increased in the order of steam, oil, and air pressure, the last being the greatest. Hydrocarbon emissions were less than NOx, but there was no set relationship.

**33531** **APTIC NO. 56593**

Jones, Kay H. and John G. Holmes

RATIONALE FOR AND FEASIBILITY OF AIRCRAFT EMISSION CONTROL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. F3-F5.*

The Environmental Protection Agency has conducted a study of emissions of air pollutants from aircraft in order to determine the extent to which such emissions affect air quality and the technological feasibility of controlling such emissions. The main pollutants found emitted from aircraft engines were gaseous hydrocarbons, carbon monoxide, oxides of nitrogen, and particulate matter. Comparison of emission densities of airport versus metropolitan areas for 1980 demonstrated that the ratio of the airport emission densities to those of the metropolitan areas will increase in most cases, sometimes dramatically. Standards have been formulated in four control option categories: retrofit control of smoke emissions and fuel venting for in-use turbine engines; application of baseline control standards for new turbine engines in 1976; standards in 1979 requiring design changes to substantially reduce emissions from the next generation of turbine aircraft and piston aircraft; and modification of ground operations to reduce taxi-idle mode emissions of current commercial aircraft at major airports. Control methods considered feasible for turbine engine emissions include the application of advanced combustor designs, while those for piston engines include most of the approaches that have been developed for automotive engines. Modification of ground operations is seen as the only strategy which will significantly reduce hydrocarbon and carbon monoxide emissions in the near future.

**33532** **APTIC NO. 56586**

Kapala, Jan

DUST CATALOG AS A BASIS FOR THE SELECTION OF DUST SEPARATION EQUIPMENT. *(Der Staubkatalog als die Grundlage fuer die Auswahl der Entstaubungsanlagen). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E140-E147.*

A dust catalog compiled in Poland for the different types of dusts emitted in the iron and steel-making process, including agglomeration, preparation, open-hearth furnace process, oxygen converter process, electric-arc process, electroslag remelting process, and ferroalloy manufacturing process, is described with the example of the open-hearth process. The charts in the dust catalog contain data on the design and technological parameters of the furnace, the waste gas characteristics, as well as the physical, electric, and granulometric properties of the specific dusts. Detailed description is given of the sites and periods of the highest dust emissions within the specific processes. In the open-hearth furnace process, the dust emissions are highest during charging, and lowest during furnace maintenance. Along with the concentration, also the physical, electric, chemical, and structural properties of the dusts vary during the open-hearth process. The zinc oxide emissions are highest during charging, and lowest during preparation of the furnace for a new charge. The dispersity of the emitted dust increases from charging to furnace maintenance. The dust catalog may serve as guidelines for the calculation of the propagation of air pollutants, for the selection of adequate dust separation techniques for the diverse technological processes, and for the elaboration of technologies permitting elimination and prevention of dust emission to the highest possible degree.

**33533** **APTIC NO. 56477**

Kneip, Theo J., Michael T. Kleinman, and Merril Eisenbud

RELATIVE CONTRIBUTION OF EMISSION SOURCES TO THE TOTAL AIRBORNE PARTICULATES IN NEW YORK CITY. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C96-C97. 4 refs.*

Automobile, oil burner, incinerator, sea salt, and soil source fractions for the period February to August 1972 were calculated for the elements lead, vanadium, copper, sodium, and potassium present in New York City aerosol in an effort to employ a mathematical technique for determining the relative contribution of emission sources to the total airborne particulates. The method involves determining the concentrations for each selected tracer element and calculating averages for annual, seasonal, and monthly periods. Linear algebraic techniques are used to analyze the data to determine the relative trace element contributions of the sources. Total suspended particulate and corresponding metal concentrations are used over a period for which source fractions are constant, and the corresponding source factors calculated and compared to those originally selected. It may be assumed where disagreement is observed, the original source factors chosen were not correct for the aerosol being studied; and a fitting process can be repeated until an effective set of source factors are generated by resolving the original matrix with calculated factors in place of the original selected factors.

**33534** **APTIC NO. 56920**

Koizumi, M.

COMBUSTION AND NITROGEN OXIDES. *(Nensho to Chisso Sankabutsu). Text in Japanese. Kogyo Kanetsu (Ind. Heating), 10(10):124-129, Feb. 1973.*

Reactions between oxygen and nitrogen require high temperatures, and once nitrogen oxides are generated nitric oxide does not decrease because it requires too much energy to break it down into N2 and O2. Coal and heavy oils generate more NOx. Measurement of NOx requires skilled workers for complete accuracy. Combustion air is an important factor in the measurement and control of NOx.

**33535** **APTIC NO. 56875**

Krienke, C. F.

DETECTION OF OIL IN OIL FIRING EQUIPMENT-GENERATED FLUE GASES. *(Die Oelfreiheit in Abgasen von Oelfeuerungen). Text in German. Oel Gasfeuerung., 9(18):28, 30, Sept. 1973.*

Elaboration of a standard method for the determination of oil residues in flue gases emitted by oil-firing equipment is proposed. The pyridine test is suggested for standardization for the determination of the presence of oil in such flue gases. Clear, uniform criteria for rating oil-firing equipment as acceptable or unacceptable regarding oil emissions should be elaborated. The elaboration of a standard method may be greatly facilitated by the observed firm relationship between the presence in flue gases of oil and unburned hydrocarbons.

**33536** **APTIC NO. 56629**

Martin, A. R. and R. A. Herrick

A STUDY OF EMISSIONS FROM 1966-1972 LIGHT-DUTY VEHICLES IN WASHINGTON, D. C. *General Environments Corp., Springfield, Va., Office of Air and Water Programs Contract 68-01-0454, Pub- APTD-1506, 103p., July 7, 1973.*

NTIS: PB 224242/AS

One hundred and seventy privately owned passenger vehicles from the Metropolitan Washington, D. C. area (model years 1966-1972) were tested for exhaust emission levels of carbon monoxide, carbon dioxide, hydrocarbons, and oxides of nitrogen according to the 1975 Federal Test Procedure. The tests were conducted on a chassis dynamometer over a 6-week period and included both cold and hot start cycles. Test results were then used to calculate emission factors based on both the 1972 and 1975 Federal Test Procedures, and punched computer cards were provided for grams of pollutant per test vehicle per test cycle. Test results are provided along with the test procedure details. (Author abstract modified)

**33537** **APTIC NO. 56489**

Matzke, Udo-Dietmar

PROBLEMS WITH THE DISPOSAL OF CAR WRECKS IN SHREDDERS. *(Probleme bei der Beseitigung von Autowracks in Shredderanlagen). Text in German. Wasser Luft Betrieb, 17(11):377-382, 1973. 13 refs.*

The Federal Republic of Germany has to deal annually with 260 million tons of waste with a volume of roughly 350 million cu m. This quantity includes one million old cars which are taken out of traffic each year. Shredders proved very suitable for the preparation of car bodies for recycling in the form of scrap. The nucleus of every shredder is the rotor with its hammers or blades. The obtained scrap has a bulk weight of 900 to 1200 kg/cu m. The bulk weight can be changed by inserting a different grate. Prior to its exit the scrap is relieved from the largest fraction of its dust through a strong air jet. The entire shredder plant can be operated without dust emission by drawing off the dust from the shredder itself as well as from the charging conveyor. The dust-laden air is frequently cleaned in a combination of a cyclone with a wet scrubber such as a venturi scrubber. With this combination the required residual dust concentration of 50 mg/cu m for uninterrupted operation can be achieved. According to the waste disposal Act of June 1972 shredders must have a distance to residential areas of 2000 m. The only single problem with the operation of shredders at present is noise, and or discussion of this theme is given.

**33538** **APTIC NO. 56857**

Peet, N. J. and J. G. Kelsey

NITROGEN OXIDES FROM UNFLUED DOMESTIC KEROSENE HEATERS. *J. Inst. Fuel, 46(388):339-340, Sept. 1973. 8 refs.*

The nitrogen oxide levels in rooms heated by two types of unflued kerosene heaters were determined. Calculations showed that under conditions of poor ventilation (0.25 air changes/hr), the nitrogen dioxide level in a 1000 cu ft room could be as high as 0.65 ppm, while the nitric oxide level could reach 1.39 ppm. These concentrations are well above the limits recommended in the United States and the Soviet Union. The blue flame convector heater caused NOx concentrations six times higher than the radiant heater. (Author abstract)

**33539** **APTIC NO. 56427**

Risser, Hubert E.

ENERGY SUPPLY PROBLEMS FOR THE 1970S AND BEYOND. *Illinois State Geological Survey, Urbana, Ill., Environmental Geology Notes No. 62, 12p., May 1973.*

The environmental implications of the energy supply problems are discussed. The importance of coal as a source of energy has decreased because of the emission of particulate matter and sulfur dioxide. There is no successful process to remove sulfur from stack gases. Research is investigating ways to remove S from coal prior to combustion and commercial and economic ways for liquefaction and gasification of coal. One of the most promising means of providing coal-based S-free fuel is the conversion of the coal to low-Btu gas. Very little coal existing east of the Rocky Mountains and only a portion of the western coal can meet standards for low-S coal. The energy consumed in hauling the coal can equal 4-5% of the energy contained in the coal being hauled. Increased energy consumption is also caused by the use of devices to control undesirable exhaust emissions from motor vehicles.

**33540** **APTIC NO. 56571**

Schwanecke, Rudolf

HOW GREAT IS THE EMISSION OF AIR POLLUTANTS FROM CHEMICAL MULTISUBSTANCE PLANTS? (Welchen Beitrag liefern chemische Vielstoffbetriebe zur Luftverunreinigung). Text in German. Luftverunreinigung, 1973:30-38, 1973. 5 refs.

Chemical multi-substance plants primarily emit nitrogen oxides, chlorine, hydrogen chloride, sulfur dioxide, and hydrogen fluoride. The organic emissions by these plants stem from evaporation losses during storage of liquids or gases, from losses during filling or emptying processes, from evaporation during heating or boiling processes, losses from distillation, filtering and drying, and leaks. The quantitative determination of these organic emissions is discussed in detail, and the equations for calculation of these emissions are given. A nomogram for determination of the pollutant concentration in the gas phase at saturation is given. For reduction of these emissions, condensation, adsorption, scrubbing, and catalytic or thermal afterburning processes are used. Condensation is primarily applied in those cases where a single or only few well condensable substances can be efficiently separated by decreasing the temperature to plus 5 C. Generally it is used only for solvent recovery. Removal by adsorption is better for molecule chains such as paraffins and aliphatic hydrocarbons than for branched out or halogenated hydrocarbons and ketones. In many cases catalytic or thermal afterburning is the most efficient method for removal of the waste gases from production of organic chemicals. Extensive safety precautions are required if this method is employed. A description of the operating principle is given.

**33541** **APTIC NO. 56851**

Teworte, Wilhelm

LEAD, ZINC, CADMIUM-PRODUCTION, USE AND EMISSIONS. *(Blei, Zink, Cadmium - Gewinnung, Einsatz und Emissionen). Text in German. Staub, Reinhaltung Luft, 33(11):422-431, Nov. 1973. 38 refs. (Presented at the VDI-Colloquium Heavy Metals as Air Pollutants, Duesseldorf, Feb. 22-23, 1973.)*

Environmental pollution by heavy metals is largely caused by human activities. Lead has been used for thousands of years, and zinc has been produced for 300 years. Cadmium is a by-product of zinc production. Produciton, consumption, and emission of heavy metals are concentrated in the industrial countries of the northern hemisphere. Lead is generally recycled, mostly in battery scrap, but zinc and cadmium applications are scattered. Emissions can be assessed from rates of produciton and consumption, the fields of application, and recycling of scrap metals and residues considering the applied technology. The lead emissions in West Germany stem mostly from the 17 million automobiles and from the treatment of ores and metals of all kinds at which lead is emitted in the form of lead oxide. The emission inventory of Cologne lists 25 tons Pb/yr for industries and 93 tons/yr for gasoline engines. These emissions were measured in an area of 521 sq km and a population of 1.15 million. The same emission inventory lists an annual zinc emission by industry at 0.1 ton. In England and Wales, where the Pb and Zn concentrations were measured in 1969 in 11 cities, the average zinc concentration was 0.91 micrograms/cu m, the average lead concentration 0.51 micrograms/cu m. The cadmium emission is more difficult to assess and is assumed to be much lower because of the relatively low quantity of 2000 tons/yr used in West Germany. It is expected that the lead and cadmium emissions (including their compounds) will be limited to 20 mg/cu m, and the zinc concentration and that of its compounds to 50 mg/cu m.

**33542** **APTIC NO. 56924**

Watanabe, K.

TREND OF LOW SULFUR CRUDE IMPORT. *(Tei iou genyo no yunyu no doko ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 40(11):1041-1061, Nov. 1973.*

Trends in low-sulfur crude oil import in Japan is discussed in relation to present and future demand, world oil reserves, classification of import oils, costs, and desulfurization techniques. Demands have increased to 100 million kl in 1972 from 10 million kl in 1955. It is estimated to reach 300 million kl in 1975. The oil import relied upon the Middle East for 88% of their product, and the South Seas for 14-16% in 1965. The average sulfur decreased to 1.53% in 1971 from 2.85% in 1965. In 1965 the purchase price was $1.95 per barrel, was lowered to $1.40 per barrel in 1969, and was restored to $1.80 per barrel in 1971. Prices are steadily increasing. Supplies of low-sulfur oil is low and costs and problems are high. Desulfurization technology is recommended, rather than efforts to acquire low-sulfur fuel.

**33543** **APTIC NO. 56608**

Willerup, Ole H.

DEGASIFICATION OF SOLID WASTE. *(Entgasung von festen Abfaellen). Text in German. Muell Abfall, 5(6):198, 1973. (Presented at the Muelltechnische Kolloquium, Stuttgart University, 25th, Sept. 21, 1973.)*

Through degasification, solid and liquid refuse can be converted into sterile slag and gas which resembles closely the composition of ordinary natural gas. The waste products are degasified in a closed externally heated retort. One furnace is composed of six retorts. The furnace has a capacity of 30 t/24 hr. The volume reduction of domestic refuse through degasification is 85 to 90%. The weight reduction is 70 to 75%. One ton of domestic refuse yields 500 cu m of gas. The average quantity of pollutants in the flue gas, which may develop at the burning of the surplus gas in the flare, is 10 ppm sulfur dioxide plus sulfur trioxide, 10 g soot, 0.5 ppm hydrogen fluoride, 10 ppm of hydrogen chloride and a $CO_2$ concentration of 7%. The gas is thoroughly scrubbed until it is free of SOx, HCl, and soot. The first such plant is in operation in Kalundborg in Denmark. It comprises a storage bunker for 120 tons, two hammer mills, a storage bunker for the shredded waste, cranes, a conveyor system between bunker and retort, a tank for liquid waste, four separate furnaces each with six ceramic retorts, a scrubbing system, a magnet separator, and a slag silo.

**33544** **APTIC NO. 56587**

Wilson, Wm. E., Jr., D. F. Miller, A. Levy, and R. K. Stone

THE EFFECT OF FUEL COMPOSITION ON ATMOSPHERIC AEROSOL DUE TO AUTO EXHAUST. *J. Air Pollution Control Assoc., 23(11):949-956, Nov. 1973. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 65th, Miami Beach, Fla., June 1972, Paper 72-169.)*

The effects of motor-fuel composition on the formation of primary and secondary automobile exhaust aerosols were studied. The aerosols were produced in an environmental chamber or dilution tunnel, with determinations being based on light scattering measurements. Exhaust was generated with seven full-boiling leaded and unleaded gasolines in a 1967 Chevrolet without emission control devices. Changes in fuel composition produced a maximum factor of three differences in light scattering due to primary aerosol. In addition to fuel composition, the most important independent variables are initial sulfur dioxide concentration, relative humidity, and initial hydrocarbon concentration. The test fuels can be divided into two groups with regard to secondary aerosol-forming potential; the fuels in the lower light-scattering group had aromatic contents of 15 and 21%, while those in the higher light-scattering group had aromatic contents of 25, 48, and 55%. The dependence of secondary aerosol formation on fuel factors is, however, a complex one and cannot be predicted solely on the basis of single hydrocarbon component reactivity scale. The two types of automobile aerosol did not have the same dependence on fuel composition. The variation in total light scattering attributable to primary plus secondary aerosol was less than that due to either component alone. Therefore, the light scattering due to automobile exhaust emissions was not significantly affected by changing fuel composition. (Author abstract modified)

**33545** **APTIC NO. 56460**

Mason and Hanger-Silas Mason Co., Amarillo, Texas, Pantex Plant

ENVIRONMENTAL MONITORING AND POLLUTANT INVENTORY PROGRAM REPORT FOR PANTEX PLANT COVERING CALENDAR YEAR 1972. *In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites, Calendar Year 1972. Atomic Energy Commission Contract DA-11-173-AMC-487(A), UC-11, p. 129-176, 1973. 11 refs.*

NTIS: WASH 1259

Data from a pollutant inventory and from radiological and nonradiological environmental monitoring are presented for the Pantex Plant in Amarillo, Texas. The plant handles large quantities of radioactive materials; and some uranium(238) is released into the atmosphere during a few special high explosives tests. Analyses were performed for uranium(238) in soil, uranium(238) in vegetation, plutonium(239) in soil, and gross activity in water. No excessive activity was discovered for any of the analyses performed. Contribution of (238)U to the soil was about 20% above background, while that to vegetation was about 40%. Investigation of the decomposition products from various high explosive formulations indicated nitric oxide nitrogen dioxide as being the major decomposition products; emission levels, however, were within the Environmental Protection Agency s Standards for incinerators operated for 1-hour period.

**33546** **APTIC NO. 56634**

Council on Environmental Quality

ENERGY AND THE ENVIRONMENTAL. ELECTRIC POWER. *63p., Aug. 1973. 200 refs.*

GPO

The environmental implications of the complex energy systems required to meet the growing demand for electric energy are discussed in a report on electric power. The environmental impacts are identified by comparing the systemwide impacts of electricity production from different fuels. The comparison is based on 1000 megawatt powerplants operating at 75% capacity for 1 yr. The impacts are those pertaining to systemwide are emissions, water discharge, land use, and occupational health and safety. The aggregated data for each electric power system as it would operate with a low level of environmental controls or with controls that are prevalent today are presented. A qualitative estimate of the severity of the impacts is provided. The index varies from 0 to 5, with 5 indicating a serious impact. The index for air emissions for the seven systems investigated are: deep mined coal, 5; surface mined coal, 5; onshore oil, 3; offshore oil, 3; imported oil, 2; natural gas, 1, and nuclear power, 1.

**33547** **APTIC NO. 56914**

SWEDEN. LONG-DISTANCE TRANSPORT OF POLLUTANTS. *(Suede. Transfert de la pollution d grande distance). Text in French. Pollut. Atmos. (Paris), no. 59:291-303, July-Sept. 1973. (Excerpts from a report presented at the United Nations Conference by the Swedish Ministers for Foreign Affairs and Agriculture.)*

Global effects of sulfur dioxide and sulfates on human health, flora, fauna, soil and surface waters in Sweden, and the problem of SO2 pollution transport into Scandinavia from Western Europe are discussed along with measures to be taken in Sweden to prevent further increase in SO2 pollution. The effects of high SO2 concentrations of localized to the neighborhood of the emission sources. Emissions of SO2 from sources outside Scandinavia are transported to Scandinavia by air masses, where they increase the acidity of the soil and the water of lakes and rivers through precipitation or absorption. Even small SO2 concentrations are able to reduce farm crops and forest wood production. Decreases by up to 0.4 unit in the pH value of river and lake water during the past decade were measured. To abate SO2 emissions, the total energy consumption should be curtailed, or another type of energy should be substituted, or fuel and waste gas desulfurization should be implemented. The atmospheric SO2 concentrations should be limited to 0.05 ppm for hygienic reasons, and to 0.02 ppm for the protection of susceptible plant species.

## 1972

**33548** **APTIC NO. 56731**

Cardinal, Paul J., Jr. and Frank P. Sebastian

OPERATION, CONTROL AND AMBIENT AIR QUALITY CONSIDERATIONS IN MODERN MULTIPLE HEARTH INCINERATORS. *American Society of Mechanical Engineers, New York, Proc. Natl. Incinerator Conf., New York, 1972, p. 290-299. 12 refs. (June 4-7.)*

Operation, control, operating costs, air emission characteristics, and future developments are reviewed for multiple hearth incinerators used for burning waste sludges. Advanced multiple hearth technology limits atmospheric emissions and optimizes combustion conditions by means of proper temperature distribution and control of oxygen within the furnace. Multiple hearth furnaces are divided into three basic operating zones: a drying zone where a major portion of the free moisture is evaporated, a combustion zone for burning at 1400 to 1700 F, and a cooling zone for cooling of ash prior to discharge. Scrubbers have significantly enhanced air pollution control of such furnaces, and the plume normally associated with wet scrubbers is readily dissipated and eliminated by mixing hot air from the furnace shaft in the induced draft fan discharge duct. Present emissions of 0.019 gm of hydrocarbons which result per person per day are compared to the expected 1975 automobile emissions of 4.8 g. Furnace performance is even more impressive on this comparative basis when carbon monoxide and nitrogen oxide emission data are examined. Reported operating costs are the lowest among all methods for ultimate disposal. Future demands for destruction of insecticides and polychlorinated biphenals may mandate that all incinerators operate with a 1600 F exhaust gas temperature and with a residence time of 2 sec. This requirement can be achieved through the multiple hearth unit by feeding sludge to the second or third hearth of the unit and altering the furnace temperature profile and excess air distribution.

**33549** **APTIC NO. 56245**

Dalager, Soren

GAS-CHROMATOGRAPHIC ATMOSPHERE STUDIES OF FISH-MEAL FACTORIES. *(Gaschromatografiske luftundersogelser omkring fiskemelsfabrikker). Text in Danish. Dansk Kem., 53(11):165-167, 1972.*

Gas chromatographic studies of the air in fish meal factories and that of the surrounding environs revealed a large number of substances which included some sulfides, alcohols, and ketones not previously reported as decomposition products of fish. Putrescine, cadaverine, indole, or skatole were not detected because of long retention times. Acetic acid and/or ethanol are indicators for fish meal odors.

**33550** **APTIC NO. 56756**

Dvirka, M.

TEMPERATURES AND AIR DISTRIBUTION IN LARGE RECTANGULAR INCINERATOR FURNACES - PART II. *American Society of Mechanical Engineers, New York, Proc. Natl. Incinerator Conf., New York, 1972, p. 217-229. 4 refs. (June 4-7.)*

Three municipal incinerator installations, designed in accordance with established heat transfer and combustion theories for improvement of temperature profiles and air distribution are discussed. A furnace temperature control concept was developed by analyzing the basic purpose of the underfire and overfire air. Proper operation of the temperature control system depended primarily on total quantities of air computed in accordance with known heat balance design procedures assuming an average constant quality refuse. The furnace temperature profiles of all three plants showed generally uniform temperatures, though there was a marked difference between the temperature log of one plant versus the other two. The dissimilarity was explainable by considering the width to length and width to height ratios of the furnace walls and arches. All three plants have been operating with markedly reduced visual emissions, indicating good combustion efficiency. Emission tests indicate a carbon monoxide content in the flue gas ranging from 0.0 to 0.08% at one plant and an average of 0.02% at another. Very low fly ash carry-over was noticed in addition to the reduction of visible emissions, and a dust loading test at the scrubber inlet of one plant indicated an order of magnitude of 0.3 to 0.4 lb/100 lb of refuse burned. Low dust loading is due to the blanket effect of overfire air introduced directly above the refuse bed and the low flame port furnace configuration which results in a downflow of the fly ash laden flue gas.

**33551** **APTIC NO. 56308**

Friswell, N. J.

EMISSIONS FROM GAS-TURBINE-TYPE COMBUSTORS. *General Motors Research Labs., Proc. Emissions Continuous Combust. Syst., 1971, p. 161-185, 1972. 16 refs.*

A combustion rig simulating gas turbine combustion was used to study pollutant emissions, particularly those of carbon and oxides of nitrogen as a function of the air-fuel mixing pattern. The use of metallic additives to remove carbon was investigated, and mechanisms were proposed to account for the action of barium and manganese in this system. The influence of combustion chamber design on NOx emissions has shown that large variations in such emissions may occur, and some correlation with primary zone residence time was found. For a given flame tube design, no influence of either overall or primary zone air-fuel ratio (AFR) on NOx levels (normalized to stoichiometry) was found. This is explainable by the existence of a combustion zone of constant AFR or diffusion-flame burning of the fuel. (Author abstract)

**33552** **APTIC NO. 56741**

Gearhart, J. W. and J. A. Benek

MEASUREMENT OF POLLUTANT EMISSIONS FROM AN AFTERBURNING TURBOJET ENGINE AT GROUND LEVEL. PART I. PARTICULATE EMISSIONS. *Aro. Inc., Air Force Contract, Proj. 3066, Program Element 62203F, Arnold Engineering Development Center, AEDC-TR-72-64, ARO-ETF-TR-72-29, 59p., 1972. 11 refs.*

NTIS,DDC: AD 744048

The smoke emissions characteristics and distribution of smoke in the exhaust plume of a J85-GE-5 engine operating at ground level were measured to determine the performance of a system fabricated in general accordance with the Society of Automotive Engineers Aerospace Recommended Practice No. 1179 for the measurement of smoke emissions from turbine engines. The measurement system provided a method of quantifying the relative smoke emissions from a turbojet engine even without visible smoke in the plume, although the technique specified in ARP 1179 was determined to introduce uncertainties of approximately plus or minus 1.5 units in the relative smoke numbers calculated as a result of reflectance measurement errors. Quantification of smoke emissions at positions other than the nozzle exit (as specified in ARP 1179) was feasible; although for emissions yielding relative smoke numbers less than approximately five, the specified procedure did not provide adequate particulate deposition for accurate smoke emission determination. The specified requirement of maintaining the engine on condition for 5 min while sample flow was drawn through the transfer line was unnecessary; a time of 1 min was adequate. The ARP 1179 specifies an uncooled probe, whereas smoke emissions at afterburning power near the nozzle exit require the use of a cooled probe due to high (greater than 3000 R) exhaust gas temperatures. Results are also presented for the engine emission characteristics.

**33553** **APTIC NO. 56755**

Hollander, Herbert I. and Newell F. Cunningham

BENEFICIATED SOLID WASTE CUBETTES AS SALVAGE FUEL FOR STEAM GENERATION. *American Society of Mechanical Engineers, New York, Proc. Natl. Incinerator Conf., New York, 1972, p. 75-86. 1 ref. (June 4-7.)*

The use of solid waste cubettes as salvage fuel for steam generation is discussed with successful burning trials at the Fort Wayne Municipal Electric Plant being cited as evidence of their applicability. Below grade fibrous materials along with small quantities of wood, rubber, leather, synthetics, textiles, and other carbonaceous materials are formed into cubettes approximately 1.5 by 1.5 by 2 in. The extruded cubette is essentially free of metals and glass which have no redeeming value as ingredients in fuel. Approximately 40 tons of such salvage cubettes were used for burning trials on two occasions at the Fort Wayne Municipal Electric Plant with no modifications to the plant equipment. The cubettes were consumed satsifactorily in the existing stoker-fired boilers. The cubettes provided 6850 to 8530 Btu/lb (air dried basis). No apparent operating difficulties with equipment were experienced with a 3 to 1 coal to cubette ratio burned, and the composite fuel bed seemed to be more free burning. The coke trees were smaller, the ash clinker smaller and less dense, and the burnout of the fuel bed quite satisfactory. There was less gas stratification leaving the fuel bed, and no apparent difference in stack gas emissions (particulate or opacity) was detectable. The cubettes have potential for being a locally derived, low-sulfur containing, supplementary fuel source which could improve the quality of stack gas emission.

**33554** **APTIC NO. 56309**

LaPointe, C. W. and W. L. Schultz

MEASUREMENT OF NITRIC OXIDE FORMATION WITHIN A MULTI-FUELED TURBINE COMBUSTOR. *General Motors Research Labs., Proc. Emissions Continuous Combust. Syst., 1971, p. 211-242, 1972. 13 refs.*

Factors affecting the nitric oxide emission level of a regenerative turbine combustor are reviewed. Differences attributable to fuel type are discussed. Temperature and composition measurements obtained with a water-cooled choked sampling probe are presented for a turbine combustor operating on two different fuels, No. 2 diesel oil and methanol. Methods of averaging the discrete data are developed. Temperature is computed from measurement of the choked sample flow rate. Methanol displays lower NO emission because of decreased high temperature residence duration, lower flame temperature, and diminished oxygen and nitrogen availability. The combustion and No formation zones occupy a small portion of the regenerative combustor, while the CO oxidation zone occupies roughly half of the combustor under investigation. The NO never reaches equilibrium values, whereas CO exceeds equilibrium values throughout most of the combustor. (Author abstract)

**33555** **APTIC NO. 56783**

Lucas, D. H. and W. D. Laing

THE AGGLOMERATION OF DUST BY DUCTS AND CHIMNEYS. *Clean Air Society of Australia and New Zealand, Proc. Int. Clean Air Conf., Melbourne, Australia, 1972, p. 95-97. 2 refs. (May 15-18.)*

Application via a computer program of a theoretical treatment on the deposition of dust on surfaces to typical power station chimneys indicates that it is probable that 20 or 30% of the particles or agglomerates greater than 20 micron in diameter will deposit temporarily on the chimney surface and will subsequently be emitted as substantially larger aggregates. The extent of this problem depends on the extent of agglomeration in the emission from precipitators. This sometimes appears to be considerable, but more quantitative information is required. Removal of agglomerates of varying sizes will occur when the dust is stripped, but there is no known theoretical treatment which allows an estimate of size distribution of these agglomerates. The finer the dust is the larger the agglomerates are. With lower gas velocities, the build-up of dust will continue for a longer time and that when finally the removal occurs, since the aerodynamic forces will be less, the dust layer will be less forcibly disrupted and larger agglomerates will result. (Author conclusions modified)

**33556** **APTIC NO. 56468**

Masek, Vaclav

DATA ON THE PROPERTIES OF FLUE DUST FROM COKE PLANTS. PART 3: PITCH COKING PLANTS. *(Neue Erkenntnisse ueber die Eigenschaften des Flugstaubes aus der Kokerei. Teil III: Pechkokerei). Text in German. Zentr. Arbeitsmed. Arbeitsschutz, 22(9):276-281, 1972. 11 refs.*

Properties of flue dust samples from a pitch coking plant were studied in a complex investigation series. Studies of the catalytic action of flue dust samples on hydrogen peroxide decomposition revealed that the flue dust samples from pitch cokery are even more inactive than normal cokery flue dust. The radioactivity of the samples was very close to the background level. The dye, vapor and gas sorption capacity of original, hydrolyzed, and aged flue dust samples was relatively low. Cultivation tests with barley and pea showed very low rate of nutrient leachout from the flue dust. The dust samples did not influence the invertase-induced inversion of saccharose.

**33557** **APTIC NO. 56764**

Mueller-Berner, A. H. and H. Hardenberg

WATER-COOLED MERCEDES-BENZ DIESEL ENGINES, MODEL 400. *(Wassergekuehlte Mercedes-Benz-Dieselmotoren, Baureihe 400). Text in German. Automobiltech. Z. (Stuttgart), 74(8):303-311, Aug. 1972. 17 refs.*

Model 400 water-cooled Mercedes-Benz diesel engines and their exhaust emission characteristics are described. While the hydrocarbon emissions from direct-injection and prechamber diesel showed no noteworthy differences, the carbon monoxide emission were much higher from prechamber diesel than from direct-injection diesel. The nitrogen dioxide emission from the direct-injection diesel was directly proportional to the load, and it declined slightly at loads exceeding three fourths of the nominal load in prechamber diesels. Retardation of the beginning of delivery was found to be the easiest way to abate the NO2 emission. However, too much retardation of the fuel injection caused increased smoke emission. Emission tests on an experimental, natural gas-powered diesel engine revealed reduced CO, total NO2 plus hydrocarbon emissions, and the total absence of smoke emissions, as compared with conventional diesel. Natural gas powered diesel engines can be used for buses in mass transportation.

**33558** **APTIC NO. 56802**

Nishida, Konosuke

ESTIMATIONS ON AUTOMOBILE EXHAUST EMISSION IN JAPANESE CITIES. *Association of Professional Engineers of Ontario, Proc. Int. Conf. Auto. Pollut., Toronto, Canada, 1972, 38p. 19 refs. (June 26-28.)*

Studies were performed to arrive at a typical Japanese driving cycle for the urban area of Kyoto, and measurements of emissions for each cycle were made by applying the procedure of the chassis dynamometer test. Duration rates for each mode were as follows: 8.6-48% on idle; 15.0-40.6% on acceleration; 0.0-63.3% on cruise; and 11.0-46.3% on deceleration. The average rate of duration for each mode obtained in the survey differed markedly from that of the Japanese four-mode cycle. Emission data for each composited cycle were as follows: 2.95% carbon monoxide and 604 ppm of hydrocarbons (as n-hexane) for the six-mode cycle, representing the driving pattern in central Kyoto and 2.76% and 610 ppm HC for the seven-mode cycle representing the surrounding zone of Kyoto. Emission data depending on the Japanese four-mode cycle did not always represent emissions during a city drive, and regulations should await more accurate information on formulating an adequate test cycle. Data are also presented for the emission of pollutants during actual driving runs on various types of roads.

**33559** **APTIC NO. 56425**

Smirnov, A. A., G. S. Berdyshev, V. P. Vetluzhskikh, A. S. Brezgin, V. F. Kholkin, and O. P. Kostritsa

EFFECT OF THE DEGREE OF CHARGE WETTING ON THE DISCHARGE OF POISONOUS GASES DURING THE EXPLOSION OF ZERNOGRANULIT 79/21. *Text in Russian. Gorn. Zh. (Mining Journal), 148(5):46-47, May 1972.*

The nitrogen oxides content in gaseous explosion products decreases with increasing water content in the explosive (Zernogranulit 79/21) up to 10%. Above 10% water, a slight increase in the NOx content was observed. The total amount of poisonous gases (NOx and carbon oxides calculated as carbon monoxide) was consistently in the 0 to 7% water content range, and it decreased a little in the 7 to 10% water range. Similar results were found for the ammonium nitrate-based mining explosive Ammonit ZhV.

**33560** **APTIC NO. 56419**

Springer, Karl J. and Clifford D. Tyree

EXHAUST EMISSIONS FROM GASOLINE-POWERED VEHICLES ABOVE 6,000-LB GROSS VEHICLE WEIGHT. (FINAL REPORT). *Southwest Research Inst., San Antonio, Tex., Environmental Protection Agency Contract EHS 70-110, Rept. APTD-1520, 421p., April 1972. 11 refs.*

NTIS: PB 220365

A nine truck evaluation of an experimental 23 mode test procedure, using both stationary and chassis-operated engines, was conducted in an effort to gain knowledge of the fundamental emissions behavior of gasoline engines in heavy duty vehicle applications. Nitric oxide, carbon monoxide and hydrocarbons were measured. The characterization studies determined that power output level consistently influenced all emissions more than any other variable and illustrated the need to measure emissions at increments approaching 10 to 15% power intervals. Speed had a relatively minor effect on emission rates. Acceleration at wide open throttle against sizeable inertia produced emissions that were representative of some steady-state conditions. The different road routes, stop-and-go, slow, intermediate, and high speed, had significant effect on hydrocarbon reduction with increase in engine speed, vehicle speed, and duty (power) level. The opposite trend was found for nitrogen oxides with minimum hydrocarbon, carbon monoxide, and NOx emissions at constant speed cruise in the neighborhood of 20 to 30 mph. Both stationary and chassis dynamometer versions of the experimental 23 mode test procedure were workable with excellent run-to-run repeatability and satisfactory chassis-to-stationary agreement. Data is summarized in the report and detailed in the appendices. (Author abstract modified)

**33561** **APTIC NO. 56256**

Syrota, J.

CHAPTER I: GENERAL ASPECTS. *(Chapitre I: Generalites). Text in French. Pollut. Atmos. (Paris), no. special:1-16, July 1972.*

General inventory of air pollution sources is presented. Industrial processes, combustion processes of any kind, and vehicles constitute the major sources of air pollution, and also a fourth category of diverse pollution sources, such as volcanoes, brands, wild incineration of wastes, and dust drift, is adopted. Ferrous and nonferrous metallurgy, aluminum plants, cement works, petroleum refineries, pulp and paper mills, and waste incineration plants generate a great variety of air pollutants among which sulfur dioxide is in a distinguished position. Other pollutants are particulate matter, iron oxides, fluorine compounds, hydrocarbons, carbon monoxide, fly ash, hydrogen sulfide, nitrogen oxides, and mercaptans. The chemical industry generated a very great variety of pollutants. Sulfur dioxide, particulate matter, NOx, and relatively small amounts of CO are generated by combustion and incineration processes. Motor vehicles emit CO, NOx, particulate matter, and, depending on the type of fuel used, also SO2.

**33562** **APTIC NO. 56259**

Syrota, J.

CHAPTER IV: THE CONSEQUENCES OF AIR POLLUTION. *(Chapitre IV: Les consequences de la pollution atmospherique). Text in French. Pollut. Atmos. (Paris), no. special:72-88, July 1972.*

The effects of air pollutants on human and animal health, plants, and buildings are reviewed. In addition to causing a nuisance, air pollutants have toxic effects with acute, subacute or chronic manifestations. The toxicity of air pollutants is increased by the presence of solid or liquid particles. While the incidence of lung cancer was found to be much higher in cities than in rural areas, no statistically secured relationship between the incidence rate and air pollution was established.

An urban factor and population density appear to be more relevant than air pollution in this respect. Relationships between the incidence of emphysema and chronic bronchitis and air pollution level was found. Reduced lung ventilatory capacity and increased susceptibility to respiratory infections due to elevated pollutant levels was noted. Instances demonstrating plant damages due to sulfur dioxide and fluorine emissions around industrial plants in France are presented. The effect of air pollutants, especially SO2, on building stones is primarily determined by such factors as the physical and chemical properties of the building materials, humidity, frost, crystallization of salts, bacteria and other microorganisms. The humidity penetrating into the pores of building materials may be aggressive due to the previous absorption of air pollutants.

**33563** **APTIC NO. 56265**

Syrota, J.

CHAPTER X: THE WAR ON INDUSTRIAL AIR POLLUTION. *(Chapitre X: La lutte contre la pollution atmospherique d origine industrielle). Text in French. Pollut. Atmos. (Paris), no. special:121-126, July 1972.*

General problems and the evolution of industrial air pollution are outlined along with legislative measures taken to abate such air pollution in France. Industrial emission studies have resulted in rules concerning the design of combustion equipment, stack heights, and the design of dust-generating industrial equipment in the cement, ore-dressing, pulp and paper and foundry industries. Modern equipment and modern technologies in industrial plants, and modernization or shutdown of obsolete plants and technologies are necessary for an effective emission control in the industry. Considerable reduction of the industrial emissions to below the present levels in twenty years despite an enormous increase in the industrial output is forecast.

**33564** **APTIC NO. 56467**

Ubisch, Hans von

VENTILATION OF MOTOR HOMES. *(Die Belueftung von Hauswagen). Text in German. Gesundh.-Ingr., 93(11):336-339, 1972. 22 refs.*

A new procedure for testing the ventilation of motor homes, based on the carbon dioxide concentration as a principal criterion, is described. According to this test, the ventilation of a motor home is satisfactory if the combustion of 10 1 1:1 ratio propane-butane gas per authorized person and hour inside the motor home does not result, under equilibrium conditions, in carbon dioxide concentrations exceeding 1%. The natural ventilation was due to temperature differences caused by occupants and heating-generating objects such as hot plates and ovens. Before attaining equilibrium conditions, both the CO2 and carbon monoxide concentrations pass through respective maxima. Abrupt increase in the CO concentration at a certain high CO2 concentration was observed.

**33565** **APTIC NO. 56738**

Wade, W. R. and W. Cornelius

EMISSION CHARACTERISTICS OF CONTINUOUS COMBUSTION SYSTEMS OF VEHICULAR POWERPLANTS--GAS TURBINE, STEAM, STIRLING. *Proc. General Motors Research Labs., Emissions Continuous Combust. Syst., 1971. p. 375-459, 1972. 54 refs.*

Unburned hydrocarbon, carbon monoxide, and nitric oxide emissions were measured from typical combustion systems of the following continuous combustion powerplants: gas turbines, steam engines, and Stirling engines. Steady-state emission characteristics of the combustion systems were then compared. The data indicate that the major problem associated with each burner was high nitrogen oxides emissions. The high NOx emission indices of the regenerative gas turbine and Stirling engine burners reflected high inlet temperatures. Although the NOx emission index of the steam engine burner was considerably lower due to operation at ambient inlet air temperature, it was higher than required by the 1976 Federal standards. The HC and CO emissions for each burner were low, and exhaust smoke and aldehyde emissions presented no serious problems. Low NO emissions require low temperatures and short residence times, while low HC and CO emissions require high temperatures and long residence times. The gas turbine burner was most amenable to NO emission control, and early quench and primary zone equivalence ratio modification proved effective means for reduction of NO emissions from this burner. Since vehicle mass emissions (grams per mile) are dependent on the emission index of the burner as well as the fuel economy of the vehicle (miles per gal of fuel burned), reductions in vehicle mass emissions can be obtained by either separate or preferably combined improvements in burner, engine, and vehicle performances. (Author abstract modified)

**33566** **APTIC NO. 56789**

Werle, D. and R. Davies

SUBMICRON SEPARATION AND DATA. *IIT Research Inst., Chicago, Ill., AFTAC/NYRC Contract F33657-71-C-0859, Proj. VT/1414/RDE/ASD, Task 1, ARPA Order no. 1702, Program Code No. 1F10, Rept. No. IITRI-C6239-A005-2, 34p., May 25, 1972. 85 refs.*

NTIS; DDC: AD 743541

A brief summary of recent literature on the nature of atmospheric releases of radioactive particulates by the nuclear industry is presented. Natural radioactivity in the atmosphere is reviewed along with the occurrence of uranium and plutonium in the air and various fission, activation, and nuclear industry-related isotopes are examined in terms of their presence in the environment. Data presented include: average content of radioactive elements and their active isotopes in igneous rocks; production rates, tropospheric concentration, and detection of cosmic ray-produced radionuclides; half-lives of some of the more important radionuclides produced by nuclear reactions; isotope concentrations in the surrounding air of a nuclear power station; principal particulate radionuclides in gaseous waste release; airborne waste data for two locations; characteristics and average annual stack release rates for eight nuclear power plants; typical releases of particulate radionuclides reported for a single year and a summary of gross radioactive waste discharges for the eight nuclear plants; stack effluent radionuclide concentration; yearly average concentration of intermediate and long-lived gamma emitting isotopes in a stack effluent; and inferred gamma dose rates at several field sites. (Author abstract modified)

**33567** **APTIC NO. 56305**

Dept. of Transportation, Washington, D. C., Federal Aviation Administration

INDIANA, WEST LAFAYETTE. PROPOSED PROJECT DESCRIPTION: LENGTHEN, WIDEN AND STRENGTHEN RUNWAYS; CONSTRUCT NEW TAXIWAY AND STRENGTHEN EXISTING TAXIWAY; GENERAL AIRPORT DEVELOPMENT; INSTALLATION OF ALS (EIS). FINAL ENVIRONMENTAL IMPACT STATEMENT. *26p., Feb. 25, 1972.*

NTIS: PB 203605F

The final environmental impact statement is presented for a proposal to expand the Purdue University Airport in Lafayette, Indiana by lengthening, widening, and strengthening runways, constructing a new taxiway and strengthening the existing taxiway, general developing of the airport, and installing of ALS. The proposed development will probably cause increased dust, heat, and fumes in the vincinity of the airport; however, these effects are not considered severe. It is anticipated that during the time-frame 1970-1980 air pollutant concentrations caused by jet activity will increase sixfold. This estimate is based upon current state of the art and does not take into consideration new developments in either emission controls or measuring procedures. Comments received from the Indiana Air Pollution Control Board indicate the project will be in compliance with the Air Pollution Control Law and Regulations.

**33568** **APTIC NO. 56330**

Dept. of Agriculture, Washington, D. C., Rural Electrification Administration

USDA FINAL ENVIRONMENTAL STATEMENT ON A 615,000 KW ELECTRICAL GENERATING UNIT NEAR BRILLIANT, OHIO. *456p., Feb. 1972. 73 refs.*

NTIS: PB 199923 F

The final environmental statement relating to the proposed Cardinal Generating Station Unit No. 3 near Brilliant, Ohio is presented. The plant will utilize a supercritical boiler-steam-turbine-condenser unit. The boiler will consume 5000 tons of coal per day. The steam will produce 615,000 kw of electricity. The coal is expected to contain 2.5 to 3.5% sulfur and 13-20% ash. A tall stack will be used for sulfur dioxide control and an electrostatic precipitator with a 99.5% design efficiency will reduce fly ash to 0.05 lb or less per million Btu input. The nitrogen oxides emissions will be approximately 600 ppm and will be stack controlled. Other information includes a complete description of the plant, water quality effects, favorable and unfavorable environmental effects, alternates to the proposed plant, consultation correspondence with the appropriate federal agencies, and review by state and local agencies developing and enforcing environmental standards.

**33569** **APTIC NO. 56390**

World Energy Conference London (England), Committee on Environmental Effects

ENVIRONMENTAL CONSERVATION AND THE ENERGY PRODUCING INDUSTRIES. *May 1972, 63p.*

The technical and economic aspects of pollution abatement practices which are in practical use or under research and development are discussed, along with relevant legal, administrative, social, and ecological considerations. In the energy producing industries, most of the air pollutants come from the combustion of fossil fuels; sizeable amounts of carbon monoxide, particulates, and sulfur dioxide are emitted. Analysis and monitoring of stack effluents, assessment of the ambient air quality, and scientific investigation of cause and effect relationships are needed. Solutions to the pollution problems involve the use of planning principles, appropriate plant siting, and technical countermeasures. Included in the latter are improvements in the diffusion of stack gases, the removal of particulates from stack gases, improvements in combustion technology, and the removal of sulfur dioxide by the desulfurization of stack gases, the desulfurization of residual oil, and fuel substitution. Such measures against air pollution nearly always involve nonproductive expenditures, with resulting increases in the cost of energy production. In highly industrialized countries, the capital investment for air pollution abatement amounts to 2 to 11% of the total construction cost of modern thermal power stations; this figure could rise further. Further developments in the methodology of the social sciences will be needed to determine the best combination of pollution abatement ways and means. Thermal pollution effects and water pollution by oil are discussed in terms of water utilization, thermal effects, countermeasures, and the pollution of water by oil. Appendices describe energy consumption and demand, ambient air quality standards for sulfur dioxide and particulates of trends in SO2, carbon monoxide, and particulates, analytical methods, control methods, and costs. (Author summary modified)

**33570** **APTIC NO. 56407**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

APPENDIX II: THE CONTRIBUTION OF PLASTICS TO AIR POLLUTION IN THE UNITED KINGDOM. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 233-243. 15 refs.*

The contribution of the plastics industry to air pollution in the United Kingdom is summarized. The principal contribution to air pollution is probably that of smell, particularly resulting from the use of organic solvents. It appears that oxidative degradation does not lead to the emission of obnoxious gases. One possible cause of odor would result from an accidental fire. The toxic products which may be obtained from combustible materials include: carbon dioxide, carbon monoxide, nitrogen oxides, hydrogen cyanide, formic acid, acetic acid, acrolein, sulfur dioxide, halogen acids, phosgene, ammonia, aldehydes, benzene, phenol, and azo-bis-succino-nitrile.

## 1971

**33571** **APTIC NO. 56317**

Decroocq, Daniel

REFINING OF CRUDE OIL. *(Le raffinage des petroles bruts). Text in French. Entropie, no. 41:51-77, Sept.-Oct. 1971. 25 refs.*

The composition and properties of crude oils and their products are reviewed. Flowsheets illustrate overall refining operations and specialized sections. The main processes used, after the crude oil had been fractionated into increasing volatility cuts by initial distillations, can be differentiated into conversion operations and scrubbing or finishing treatments. The thermal or catalytic cracking of heavy products, the catalytic reforming of naphthas, the isomerization and synthesis of gasolines, and the hydrodesulfurization of distillates are discussed in detail.

**33572** **APTIC NO. 56658**

Feldstein, Milton

COMBUSTION EMISSIONS FROM STATIONARY SOURCES. *In: Combustion- Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 291-318. 13 refs.*

Emission data from the San Francisco Bay Area Air Pollution Control District reflecting the combustion of fuel for space heating, water heating, industrial steam generation, and the incineration or burning of solid waste, including agricultural waste are presented for organics, (odorous gases, aldehydes, acids) carbon monoxide, sulfur oxides, nitrogen oxides, and particulates. Additional data on polynuclear hydrocarbon emissions for coal-fired furnaces are also provided, and regulatory controls for combustion emissions in the Bay Area are outlined.

**33573** **APTIC NO. 56421**

Fine, David H., Steven M. Slater, Adel F. Sarofim, and Glenn C. Williams

THE IMPORTANCE OF NITROGEN IN COAL AS A SOURCE OF NITROGEN OXIDE EMISSION FROM FURNACES. *Preprint, American Inst. of Chemical Engineers, 33p., 1971. 19 refs. (Presented at the American Institute of Chemical Engineers, Annual Meeting, 64th, San Francisco, Calif., Nov. 28-Dec. 2.)*

Results on the conversion of fuel-nitrogen to nitric oxide in both diffusion and premixed flames are presented, and mechanisms are postulated for the nitric oxide formation. Models of pulverized coal combustion are also reviewed and used to examine the conditions under which fuel-nitrogen contributes significantly to nitric oxide emission. Conversion efficiency of fuel-nitrogen to nitric oxide appears considerably greater in premixed than in diffusion flames. A major fraction of the fuel-nitrogen in pulverized coal flames is probably volatilized prior to combustion and burns in flames that exhibit many of the characteristics of diffusion flames. The conversion of fuel-nitrogen to nitric oxide formation is therefore thought to be relatively small under conditions encountered in pulverized coal flames favoring high rates of caol devolatilization. Proper assessment of the contribution of the fuel-nitrogen to nitric oxide formation in pulverized coal furnaces is inhibited by the lack of data on the nitrogen containing pyrolysis products from coal, the amount of nitrogen volatilized at the high heating rates typical of furnaces, the nature of the pyrolysis intermediates, and a detailed knowledge of nitrogen flame chemistry. (Author conclusions modified)

**33574** **APTIC NO. 56471**

Jones, H. R.

AIR POLLUTION BY MERCURY. *In: Mercury Pollution Control. Noyes Data Corp., Park Ridge, N. J., 7p., 1971. 17 refs.*

Exposed mercury, because of its high vapor pressure at room temperature, constantly emits vapors into the environmental air; hence, the element and its compounds present potential air pollutant hazards if not carefully controlled. Mercury compounds normally exist in the ambient air as aerosols. Major sources of air pollution by Hg compounds are the industrial manufacturers and users of these compounds; agricultural use of organic Hg compounds as pesticides may also be a source of air pollution. One other source of Hg air pollution is simply the burning of fossil fuels. A reasonable estimate of the average concentration is at least 1 ppm, and an annual consumption of 500 million tons of coal per year would contribute one million lb of Hg per year to the environment. The rate of vaporization for Hg increases very rapidly with increase in temperature, and the atmospheric concentration will approximately double for every 10 C increase. Some concentrations for Hg content of suspended particulate matter and Hg vapor of different urban locations are presented, though the data collection represent an inadequate sampling of the United States and fail to give trends for the future.

**33575** **APTIC NO. 56474**

Jones, H R.

THE PRODUCTION OF MERCURY. *In: Mercury Pollution Control. Noyes Data Corp., Park Ridge, N. J., 29p., 1971. 4 refs.*

United States and world mercury production is reviewed, and various devices and processes for the production of the metal are examined in detail. Mercury production is relatively small and in quantity ranks tenth in world output of nonferrous metals. Production of secondary Hg in the United States has risen from 8360 flasks in 1961 to 33,405 flasks in 1968. The production processes employed include: roasting sulfide ores, leaching from ores, and electrolytic oxidation of sulfide ores. Process parameters and apparatus detail are provided for each of these. The classic process for recovering Hg from its ore has been a pyrometallurgical technique wherein the ore is merely heated to oxidize the cinnabar and volatilize the Hg or its compounds and the Hg condensed. This process has a number of disadvantages, the principle one being a relatively low recovery of Hg from low grade ores. The process further constitutes a health hazard unless adequate precautions are taken, and there is also an air pollution problem

**33576** **APTIC NO. 56709**

McCrackin, Francis A.

BROAD VIEW OF THE ENVIRONMENT. A NATIONAL CRISIS. PROGRESS, PEOPLE AND POLLUTION. *In: Environment. Southern California Edison Co., 1971, 71p. 43 refs.*

A reference and teaching text for the Environmental Education Program at the Southern California Edison Co. presents a broad view of the environment and describes such air pollution factors as photochemical smog, oxides of nitrogen, sulfur dioxide, particulate matter, carbon monoxide, and carbon dioxide, Physical properties, emission sources, atmospheric interactions, and control procedures are outlined for each of the pollutants. The future threat of CO2, the ultimate pollutant, to the ecosystem by means of the greenhouse effect is also described.

**33577** **APTIC NO. 56455**

Merritt, A. C. and C. W. Gorton

WASTE MANAGEMENT PROBLEMS IN GEORGIA INDUSTRIES. *Georgia Inst. of Technology, Atlanta, Ga., High Temperature Materials Div., Proj E-300-101, 81p., July 1, 1971. 19 refs.*

A survey of the pollution problems of three of the major industries of Georgia, viz., carpet, poultry, and wood products, was conducted by a search of the literature and by individual site visits at certain industrial locations. The recommended study of destructive distillation for use of waste carpet trim as a raw material is seen as requiring a clear understanding of the combustion of the waste in a particular furnace in order to avoid the problem of air pollution. The feasibility of disposing of manure in poultry operations by means of combustion is another area that was recommended for study. Particulate emission from the burning of bark as fuel or the burning of other wood wastes was noted as a primary problem of the wood products industry. A new process should be developed for the production of a fuel source from bark while eliminating the fly ash problem; such a process might result from concepts similar to the destructive distillation of wood to obtain methanol. Basic research in the area of particulate formation during combustion is also needed. One other major polluton probem in the wood products industry is the odor formation in the kraft process. Char produced in the process might be used as an adsorbent material for the elimination or reduction of the sulfur compounds (hydrogen sulfide, mercaptans, sulfur dioxide) which probably cause most of the odor.

**33578** **APTIC NO. 56653**

Starkman, Ernest S.

VEHICULAR EMISSIONS AND CONTROL. *In: Combustion-Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.). New York-London, Plenum Press, 1971, p. 205-237. 42 refs.*

Principles of operation, source and character of pollutants, and systems for control of emissions are presented for spark-ignition, diesel, and gas turbine engines. Potential air pollutants from motor vehicles can be introduced into the atmosphere from the exhaust, crankcase vent, carburetor, and fuel tank; and those materials, which are produced by the reciprocating engine as a consequence of the combustion process can contain all of the following: unburned hydrocarbons, carbon monoxide, oxides of nitrogen, polynuclear aromatic hydrocarbons, particulate matter, lead, odor, (aldehydes) and oxides of sulfur. Fuel-air mixture effects on the emission of major vehicular pollutants are graphically depicted, and typical exhaust gas compositions are given for various modes of operation. It appears technically feasible to produce gasoline engine powered cars within a six year period that will have an exhaust gas content of no more than 0.5% carbon monoxide, 50 ppm unburned hydrocarbons, and 250 ppm nitrogen oxides. Alternatives to the piston engine are also reviewed.

**33579** **APTIC NO. 56772**

Vaughan, William P. and Stephen P. Fuller

MERCURY VAPOR EMISSIONS: REPORT ON AERIAL SURVEY OF SOURCES POTENTIALLY AFFECTING THE AIR IN ILLINOIS. (FINAL REPORT). *Washington*

*Univ., St. Louis, Mo., Contract 10.008, Rept. IIEQ 71- 3, 22p., June 1971. 13 refs.*

NTIS: PB 204520

The feasibility of rapid aerial detection of mercury emitters was demonstrated. The survey was done with an ultraviolet spectrophotometer which detected the absorption of light at 2536.5 A by atoms of Hg vapor. Estimations of annual output were made using Briggs equations for buoyant plumes.) Fossil fuel burning power plants, municipal incinerators, and several industrial sites are emitting measurable quantities of elemental mercury vapor. Estimated outputs range between 100 lb/yr and 5400 lb/yr of Hg vapor for the 12 sites where sufficient information was available. The eight power plants account for 8700 lb/yr emitted into the atmosphere. The four incinerators emit an estimated 12,770 lb/yr into the atmosphere. Fluctuation in calculated outputs among power plants can in part be attributed to differing levels of Hg in the coal consumed, independent of sample variability.

**33580** **APTIC NO. 56726**

Dept. of the Air Force

FINAL ENVIRONMENTAL STATEMENT FOR F-15 AIRCRAFT. (FINAL REPORT). *AF-ES-71-3F, 35p., Sept. 17, 1971.*

NTIS: PB 201710-F

The environmental impact and adverse environmental effects of the Air Force F-15 aircraft are summarized. The major environmental impacts are air pollution and noise. These are not considered as adverse environmental effects, compared to present systems. The exhaust smoke content of the F-100 jet engine planned for installation in the F-15 is specified to be below the visible level and is expected to be about 19%. Typical carbon monoxide values for the F-100 engine are 2 to 3 lbs of CO/1000 lbs of fuel at 95% speed and 80 lbs at 60% speed (idle). The formation and emission of unburned hydrocarbons are still uncorrected problems in the altitude, but have been reduced at ground level by as much as 40-50 lbs of hexane/1000 lbs of fuel at the 60% idle speed to 25 lbs and 2-3 lbs at the 95% point to practically nothing. The JP-4 fuel used in the F-15 is very low in sulfur with a total maximum by percent of 0.4. Demountable exhaust mufflers will be used with the F-15 base operations. The F-100 maximum noise levels are about 125 decibels at the inlet and 138 decibels at distances of 250 ft. The afterburner is not used in the F-15 and the low noise turbofan engine design assures a lower noise level than produced by a previous high performance jet fighter aircraft.

**33581** **APTIC NO. 56758**

Council on Economic Priorities

PAPER PROFITS: POLLUTION IN THE PULP AND PAPER INDUSTRY. *In: Economic Dislocation Resulting from Environmental Controls. 92nd Congress (Senate), First Session, Serial No. 92-H19, p. 81-127, 1971. 33 refs. (Hearings befory the Subcommittee on Air and Water Pollution of the Committee on Public Works.) (Also: Econ. Prior. Rep., 1(6):3-46, Dec.-Jan. 1971.)*

GPO

The Council on Economic Priorities undertook and in-depth study of the causes of air and water pollution in the pulp and paper industry and the steps which have been taken by the 24 largest U. S. paper companies in reducing pollution at their 131 pulp mills. The four major pulping methods (groundwood, NSSC, sulfite, and kraft) are discussed along with the amount of air and water pollution they cause. This is followed by an analysis of the pollution control techniques now available to the industry: methods of primary, secondary, and tertiary water treatment; and equipment for the control of soot, ash, and gaseous emissions. A table of the time needed to install the necessary equipment and the costs involved is included. A review is then presented of State and Federal laws regulating pollution, the various degrees of enforcement effort in different states, and the meaning of compliance with existing laws. With regard to the study itself, a review is presented of how it was carried out and the results obtained. Charts show total production and water use at all 131 mills, the amount of water treatment, the extent of air control efforts, and the expenditures that will be needed by the mills to achieve State-of-the-Art pollution control status. A financial review of each company follows, along with an overview of efforts to control pollution at the pulp mills and a report of each mill s history, equipment, plans for future equipment, amount of money spent and budgeted, and legal status. Each mill is then evaluated. A listing of the pollution control agencies and the content of the laws in each of the 27 states where pulp mills are located is appended. (Author summary modified)

## 1970

**33582** **APTIC NO. 56291**

Healy, Gerald D., Jr.

THE LOUISIANA SOLID WASTE DISPOSAL PROGRAM. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 17-20, 1970. 4 refs. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

The current trend in Louisiana for disposal of solid wastes is away from air-polluting incineration and toward sanitary landfills. A 1967 survey revealed that 242 communities operated some 300 open dumps, nine sanitary landfills, and 14 incinerators. Disposal of municipal solid waste was 13.8% by incineration, 1.2% by sanitary landfill, and 85% by open dumping and open burning. A 1970 breakdown indicated 15% by incineration, 25% by sanitary landfill, and much of the remaining 60% by open dumps without burning. A continued improvement is planned through the cooperation of the State Department of Health, the Air Control Commission, and the Stream Control Commission. The ultimate solution to the solid waste problem will result from: research in new and improved disposal methods; controlled use of disposables; use of bio-degradable packaging; salvage and recycling; raw material or process changes to control waste production; by-product development to eliminate waste; adequate financing through acceptance of the utility concept; cooperation between public agencies and industries for efficient, economical, and sanitary solid waste management; and areawide long-range solid waste planning.

**33583** **APTIC NO. 56290**

Heil, T. C.

HOW A SOLID WASTE DISPOSAL PROGRAM WILL AFFECT AIR POLLUTION IN THE SHREVEPORT AREA. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 42-60, 1970. 5 refs. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

An outline of a program adopted by the city of Shreveport, Louisiana for the reduction of air pollutants emanating from public waste disposal facilities is presented along with a summary of the results of studies and investigations to determine present and future quantities of solid waste generated. Over 600 tons per day of refuse are presently delivered to City operated facilities, and this amount is expected to increase to approximately 1900 tons by 1990. A combination of central incineration and sanitary landfill is recommended for construction in two phases of a capital improvements program to dispose of these great quantities. Capital improvements over the twenty year life of the plan are estimated to total $14,350,000. Efficient burning and use of gas cleansing equipment will reduce smoke and particulate emissions to acceptable levels, though much improvement is recognized as still being needed for present day emission control equipment. Ninety percent removal of solid particulates can be attained at reasonable cost and reliability, but to attain 98% removal the cost increases 10-15 times and reliability becomes a matter for concern. Electrostatic precipitators which have been used in Europe on municipal incinerator plants are being reviewed, but few have been installed in this country and have not been in service long enough to accurately be evaluated.

**33584** **APTIC NO. 56375**

Risser, Hubert E.

POWER AND THE ENVIRONMENT--A POTENTIAL CRISIS IN ENERGY SUPPLY. *Illinois State Geological Survey, Urbana, Ill., Environmental Geology Notes No. 40, 49p., Dec. 1970. 85 refs.*

The environmental aspects of power generation are discussed in a report on the potential energy crisis. Natural gas is the cleanest of the three fossil fuels. Oil and coal contain sulfur compounds which are converted to sulfur oxides. They are controlled by limiting the amount of S contained in the fuel. Fuel can be desulfurized for 40-50 cents per barrel. The emission of fly ash in coal can be controlled by devices that electrically precipitate or otherwise remove the material from the stack gases. The disposal of the collected ash is a further environmental problem. Public concern over nuclear generating plants stem from fear of radioactive emission and disposal of radioactive waste materials. Concern over the environmental effects of the discharge of heat into natural bodies of water is steadily mounting. Increases above the natural temperature of lakes and streams is reported to effect changes in the growth rate and the species of aquatic flora and fauna.

### 1969

**33585** **APTIC NO. 56631**

Holt, Charles S.

MILWAUKEE METROPOLITAN AREA AIR POLLUTANT EMISSION INVENTORY. *National Air Pollution Control Administration, Durham, N. C., Air Quality and Emission Data Div., Rept. APTD-0883, 63p., Feb. 1969. 6 refs.*

NTIS: PB 220481

Results are presented from a Milwaukee Metropolitan Area Air Pollutant Emission Inventory based on the rapid survey technique. Total emissions of sulfur oxides, nitrogen oxides, hydrocarbons, carbon monoxide, and particulates were estimated with respect to source type, season of the year, and geographical distribution within the area for approximated conditions of the year 1967. The study area included three Standard Metropolitan Statistical Areas, viz., Milwaukee, Racine, and Kenosha; the addition of Walworth county to these three SMSA s made the study area coincide with the area designated by the State of Wisconsin as Region II. Information on 80 major point sources was gathered, emissions calculated, and the information located on a grid reference system. Emissions not attributable to large point sources were apportioned to the 48 grid squares and contributed to area source totals. A summary of the 1967 emissions for each of the five pollutants has been tabulated for the following source categories: transportation (road vehicles, other); stationary sources (industry, residential, commercial, utility power plants); solid waste disposal; and industrial processes. (Author abstract modified)

## CONTROL METHODS

### 1973

**33586** **APTIC NO. 56519**

Acres, Gary J. and Barry J. Cooper

PLATINUM CATALYST SYSTEMS FOR CAR EXHAUST EMISSION CONTROL: THE EFFECT OF FUEL AND OIL ADDITIVES ON CATALYST DURABILITY. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. F14-F17. 2 refs.*

Studies of the effect of fuel and oil additives on durability of platinum catalyst systems for automobile exhaust emission control have indicated that the major chemical interactions causing deactivation of catalysts are due to lead from the fuel and phosphorus from the fuel and oils; sulfur and other additive elements present cause no significant deactivation with oxidation catalyst systems. The poisoning processes show a first order dependence on poison concentration, the rate of poisoning being proportional to the poison level in the fuel and oil and the consumption of fuel and oil during testing. The low proportion of lead and phosphorus found on the catalyst samples after engine tests indicated that the greater proportion of these materials is converted to non-toxic species, possibly particulates, which do not adhere to the catalyst surface. Interactions were found to occur between poisons in an exhaust environment giving lower deactivation rates than if the poison were present alone; thus, any interpretation of poisoning rates must take into account such interactions. Evaluation of the effect of lubricating oils on catalyst performance indicated that organo phosphorus additives cause the most severe problems and are more toxic than lead on a weight for weight basis.

**33587** **APTIC NO. 56818**

oki, Michikazu

COUNTERMEASURES FOR NITROGEN OXIDES FROM AUTOMOBILES. *(Jidosha sangyokai ni okeru NOx taisaku (Gaikyo)). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 9(9):920-927, Sept. 1973.*

Emissions of nitrogen oxides by automobiles, Japanese and American NOx standards, and control methods are discussed. Nitrogen oxide emissions in Tokyo include 173,000 tons/yr (39.0%) from cars, 95,400 t/yr (21.5%) from power plants, 137,600 t/yr (31.0%) from industry, and 37,600 t/yr (8.5%) from other sources. The effect of air/fuel ratio, compression ratio, engine modification, spark timing, water injection, and exhaust gas recirculation on NOx emissions from cars are discussed.

**33588** **APTIC NO. 56943**

Attlmayr, Ernst

PROPER CALCULATION OF THERMAL INSULATION IN OVERGROUND BUILDING INDUSTRY. *(Scharf kalkuliert: Waermeschutz im Hochbau. Bessere Luft fuer weniger Geld). Text in German. Umwelt (Duesseldorf), no. 5:66-67, Oct.-Nov. 1973. 6 refs.*

The possibility of considerably reducing domestic heating and energy demands, and consequently the domestic heating-generated air pollution which now amounts to 60% of the total emissions in big cities, by proper heat insulation of buildings (especially apartment houses and family homes), is emphasized. The economically optimized heat insulation of buildings represents a measure both to abate pollutant emissions due to the reduced fuel demand and to reduce heating costs. The use of triple windows, though expensive, should be considered, especially in cold climates.

**33589** **APTIC NO. 56639**

Blakeslee, C. E. and A. P. Selker

PILOT FIELD TEST PROGRAM TO STUDY METHODS FOR REDUCTION OF NOX FORMATION IN TANGENTIALLY COAL FIRED STEAM GENERATING UNITS. *Environmental Protection Agency, Research Triangle Park, N. C. Proc. Coal Combust. Semin., Research Triangle Park, N. C., 1973, p. 287-304. (June 19-20.)*

NTIS: PB 224210/AS

Results are presented from the first phase of a pilot field test program for studying methods of reducing nitrogen oxides formation in tangentially coal-fired steam generating units. The lowest cost method for control was found to be overfire air which results in a .14 to .50 $/KW additional unit cost for a new or existing unit, respectively. This method incurs no loss in unit efficiency or increased operating expenses. Gas recirculation, introduced either through the secondary air ducts or the coal pulverizers and primary transport air system, results in higher equipment costs than overfire air and requires additional power for fan operation. Water injection introduced into the fuel firing zone of the unit is attractive from the standpoint of low initial equipment costs; however, losses in unit efficiency resulting in increased fuel costs and significant water consumption make it the most expensive system to operate. The use of either gas recirculation or water injection in existing units could result in a 10-20% decrease in load capability due to increased gas flow weights.

**33590** **APTIC NO. 56910**

Caron, J. and F. Rey

INCINERATION OF INDUSTRIAL WASTE GASES. *(Incineration d effluents gazeux d origine industrielle). Text in French. Ing. Tech., no. 277:21-27, July-Aug. 1973.*

The principles and possible uses of thermal and catalytic afterburning of industrial waste gases are described. Thermal afterburning is applicable to waste gases containing dusts that cannot be removed prior to combustion, to smokes containing catalyst poisons, and to smokes and waste gases with high calorific value. The temperature ranges required for the thermal afterburning of malodorous emissions, hydrocarbons, and for the oxidation of carbon monoxide are 500-820 C, 600-850, and 650-750 C, respectively. Thermal afterburning is most efficient using natural gas as an auxiliary fuel. The gas flow rate in the afterburning chamber should be in the order of magnitude of 10 m/sec, and a reaction time of 0.5-0.8 sec should be maintained. Catalytic afterburning by means of catalysts applied on ceramic or metallic support requires a flow rate of 1 to 2 m/sec for sufficient contact time between the catalyst and the gas components to be oxidized.

**33591** **APTIC NO. 56517**

Chamberland, Andre M. and Antoine Theoret

PYROLYSIS OF SOLID WASTES: A POLLUTION-FREE RECYCLING TECHNIQUE. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E98-E100. 14 refs.*

Pyrolysis of solid wastes is examined as a pollution-free recycling technique which allows the recovery of either useful raw material or energy in a form which can easily be stored. The process involves heating the organic material to a high temperature in an oxygen-free or low oxygen atmosphere and is analogous to a distillation process. The organic materials are chemically broken down into three component streams: a gas consisting primarily of hydrogen, methane, carbon monoxide, and carbon dioxide; a tar or oil that is liquid at room temperature; and char. Several pilot plants have been operated and successfully tested in the past few years, and it appears that the process is now ready for large-scale operation; results obtained for two pilot operations are listed in terms of products of pyrolysis and heating value. One study has indicated that each ton of solid waste should produce 0.40 ton of fuel which could be sold at $12.50 a ton, meaning that one ton of refuse would product $2.85 of saleable fuel. Net operating cost estimates make pyrolysis an attractive technique compared to incineration and a serious competitor to sanitary landfill.

**33592** **APTIC NO. 56694**

Cheng, Lung

COLLECTION OF AIRBORNE DUST BY WATER SPRAYS. *Ind. Eng. Chem. Process Design Develop., 12(3):221-225, July 1973. 12 refs.*

A general theoretical equation was developed for the collection efficiency of airborne dust particles by spray drops. The model assumes an inertial impaction collection mechanism and is based upon mean inter-drop length and mean interparticle area. Particular attention was given to the optimum drop size for collection with open and confined sprays from a high-pressure nozzle. This general model was specifically adapted to the collection of dust particles in a horizontal tunnel by a solid-cone water spray by including the effects of dust size and spray configuration. The theoretical collection efficiencies agreed reasonably well with experimental data. The present results can be used to select a specific spray nozzle that will provide optimum collection efficiency for air borne dust based the available water flow rate and line pressure. (Author abstract)

**33593** **APTIC NO. 56669**

Crawford, A. R., E. H. Manny, W. Bartok, and R. E. Hall

NOX EMISSION CONTROL FOR COAL-FIRED UTILITY BOILERS. *Preprint, Am. Inst. Chem. Engrs., New York, 31p., 1973. 6 refs. (Presented at the American Institute of Chemical Engineers, Annual Meeting, 66th, Philadelphia, Pa., Nov. 11-15, 1973, Paper 23.)*

Field studies on nitrogen oxides emission control for coal-fired utility boilers were conducted. Analysis of the gaseous emission data shows that combustion operating modifications, chiefly low excess air firing coupled with staged burner patterns, can reduce NOx emissions from coal-fired boilers by 25 to 60%, depending on the unit and its flexibility for modifications. The NOx emissions measured were successfully correlated for both normal and modified firing conditions with the per cent stoichiometric air supplied to the burners. There appear to be no major differences between particulate loadings under baseline and low NOx operating conditions. Unburned carbon in the fly ash appears to increase considerably with low NOx firing for front wall-and horizontally opposed-fired boilers and decrease substantially for tangentially-fired units. If confirmed by more detailed testing, the potential debits in overall performance based on these limited data for front wall-and horizontally opposed-fired boilers may be offset by improved efficiencies realized by lower excess air operation in low NOx firing. (Author summary modified)

**33594** **APTIC NO. 56687**

Darling, S. M., R. W. Snyder, and W. T. Wotring

ANTICIPATED INFLUENCE OF EMISSION CONTROLS ON USE OF FUEL AND LUBRICANT ADDITIVES. *American Chemical Society, Washington, D. C., 39p., 1973. 39 refs. (Presented at the American Chemical Society, National Meeting, 166th, Chicago, Ill., Aug. 26-31, 1973.)*

The anticipated influence of emission controls on use of fuel and lubricant additives is discussed. The conventional piston engine equipped with catalytic converter and various additional add-on equipment will predominate in the emission controlled car short range (1975-80). There are implications with respect to fuel and lubricant additives. The present legislatively designated lead-free fuel and current quality motor oils will be endorsed by the manufacturers as acceptable for the 1975 model year. Increased emphasis will be placed on the use of effective detergent dispersant additives in the fuel. Fuel cleanliness and stability will be essential to maintaining the function of finely tuned control devices. These additives will be limited to compounds of carbon, hydrogen, oxygen, nitrogen, and perhaps sulfur. New additive developments will focus on improvement of the high temperature stability of fuels to minimize their contribution to hot spot deposits. The most questionable oil components are phosphorus and total ash content. At present neither are serious threat to catalytic converter durability. Policy on mandatory inspection and enforcement of emissions control effectiveness on all vehicles over their service lift will be developed slowly, and will intensify durability problems by focusing attention on the individual vehicle rather than on average performance by type or class, as had been done to data. (Author summary modified)

**33595** **APTIC NO. 56415**

Demetri, E. P. and R. J. Murad

LOW NOX EMISSION COMBUSTOR FOR AUTOMOBILE GAS TURBINE ENGINES. *Northern Research and Engineering Corp., Cambridge, Mass., Office of Air and Water Programs Contract 68-04-0017, APTD-1454, 182p., Feb. 1973. 26 refs.*

NTIS: PB 222340

Design guidelines were developed for use in the design of automotive gas turbine combustors capable of achieving emission levels not exceeding one-half the Federal 1975/76 emission standards. Two combustors were developed: one was representative of low pressure-ratio, regenerative gas turbine cycles, and the other was representative of high pressure-ratio, nonregenerative cycles. The approach adopted for controlling the emission involved extensive modifications to conventional combustor configurations, making direct use of existing combustor design technology; specifically, both combustors were designed to operate with a lean, well-mixed primary zone over the full range of operating conditions. An airblast type of fuel nozzle was used for fuel injection. Both combustors were designed with a single-can, throughflow configuration. In general, the nitrogen oxides emission obtained were higher than the goal, while the carbon monoxide and hydrocarbon emissions were satisfactory. The high NOx emissions were principally due to inadequate fuel/air mixing in the primary zone and could be reduced by improving the uniformity of the primary zone fuel/air distribution. Combustor performance parameters such as combustion efficiency, stability limits, pressure loss, exit temperature traverse quality, and combustor wall temperature were satisfactory. The variable geometry concept utilized has the potential of producing the necessary reductions in emission levels. (Author summary modified)

**33596** **APTIC NO. 56432**

Dimitroff, Edward

FUEL ADDITIVES--A NEW ROLE. *Preprint, American Chemical Society, Washington, D. C., 23p., 1973. (Presented at the American Chemical Society Symposium on Additives for Lubricants and Fuels, Chicago, Ill., Sept. 26-31, 1973.)*

Three relatively new fuel additive developments for use in internal combustion engines are described. Apparatus was developed to determine the induction system deposit (ISD) tendencies of gasolines or the effectiveness of additives in inhibiting the formation of intake valve deposits. The mechanism involves precursor decomposition and free radical formation, oxidation, and molecular recombination of two or three free radicals. Flame propagation modifiers are being used to modify the initiation and reaction rate of the pre-flame reactions. The organic peroxides and nitrates are the most commonly used and they can significantly decrease the fuel ignition delay and thus improve engine combustion. An engine exhaust nitric oxide emission control scheme is described. It is due to the effect of NO-free EGR flow reaching the engine carburetor and combustion chamber. One cc additive/hr/100 cu ft of EGR flow is required for a 99% effective neutralization of NO.

**33597** **APTIC NO. 56775**

Dulling, O. E.

GETTING THE BUGS OUT OF ELECTROSTATIC PRECIPITATORS. *Air Pollution Control Assoc., Pittsburgh, Pa., Proc. Spec. Conf. Des. Oper. Maint. High Effic. Contr. Equip., St. Louis, Mo., 1973, p. 79-87. (March 29-30.)*

The design of electrostatic precipitators is discussed. Overall precipitator performance is largely a function of electrode alignment and reliability. Electrode alignment relates to the spacing between the high voltage (discharge electrode) system and the ground (collecting electrode) system. Since design rigidly fixes the position of the collecting electrode system, it is imperative that the discharge electrode system be designed and installed to retain clearance. The second most important factor for good precipitator dust collecting performance is the effectiveness and reliability of the collecting electrode rappers and discharge electrode rappers which remove the dust from the electrode systems. Owners should set up a regular program of inspection of rapper operation. The sequence of operation of rappers is an important factor in precipitator design. Staggered rapping frequency for the collecting electrodes and discharge electrodes is recommended. The precipitator design should assure that the vertical shaft connecting the collecting electrode plates to the rappers at the operating floor does not bind on the side of the sleeve through which the shaft passes. Sufficient data must be made available to the vendor concerning the gases to be treated so that knowledgeable decisions can be made on the best means of dealing with potential corrosion of the precipitator shell and internal parts. Initial efforts can be made to facilitate maintenance by providing adequate working clearances and by providing a separate electrical system and transformer for each cell. Provisions for an extra cell in each gas passage should be included and sufficient space between the source of gas and the stack to install ductwork is recommended. Equipment that seems obviously oversized should be chosen.

**33598** **APTIC NO. 56416**

Eatock, H. C., J. A. Saintsbury, P. Sampath, J. R. Keilbach, and L. J. Spadaccini

LOW NOX EMISSION COMBUSTOR FOR AUTOMOBILE GAS TURBINE ENGINES. (FINAL REPORT). *United Aircraft of Canada, Ltd., Longueuil (Quebec), Office of Air and Water Programs Contract 68-04-0015, APTD-1457, 261p., Feb. 1973. 14 refs.*

NTIS: PB 222075

Two automotive combustors representing a 12:1 pressure ratio simple cycle gas turbine and a 5:1 pressure ratio regenerative cycle gas turbine were developed in an attempt to equal or better the 1975-76 Federal emission standards for automobiles. Sixty atmospheric rig tests were carried out on the simple-cycle combustor, while 39 rig test were carried out on the regenerative cycle combustor, 430 pressure test points involving over 200 modifications to combustor geometry were run. The air-blast atomizer was selected as the fuel injection apparatus. Essentially, the best combustor results were obtained via the introduction of sufficient air to provide a lean head end (in the form of three stages of swirl) while maintaining fairly high temperatures in the intermediate zone, the remainder of the air being introduced into the dilution zone. The simple cycle combustor was thus able to achieve nitrogen oxides emission levels of 0.52 g/mi, carbon monoxide levels of 3.64 g/mi, and hydrocarbon levels of 0.49 g/mi. The levels attained by the regenerative cycle combustor were 0.58, 6.18, and 0.06 g/mi, respectively. Both combustors had excellent stability, indicating that further development could result in substantially greater emission reductions. With further development, the simple cycle combustor should be able to meet 1976 Federal emission standards. The regenerative cycle combustor will probably require variable combustor geometry and/or partial heat exchanger bypass to the combustory primary zone to achieve Federal standards. (Author summary modified)

**33599** **APTIC NO. 56480**

Eisenburger, Johann-Peter

MELTING OF WASTE. *(Schmelzen von Muell). Text in German. Muell Abfall, 5(6):199-202, 1973. (Presented at the Muelltechnische Kolloquium, Stuttgart Univ.*

A furnace for melting refuse is described. The waste material enters the furnace through a double lock and an annula slot formed between external jacket and internal cylinder. On its way to the melting chamber the waste is uniformly distributed. The melting chamber resembles an autoclave of cylindrical shape and low height compared to diameter. Suspended from the lid is the internal cylindrical muffle with a ceramic-lined bottom. Here ignition and auxiliary burners are centrically arranged. The internal cyclinder is surrounded by a rotary sleeve driven by two on opposite sides externally arranged drives. The rotary sleeve is surrounded by a stationary sleeve. The bottom outlet of the melting chamber leads to the outlet chamber for the melt. The flue gas developing during the combustion process is led to the afterburning chamber which is horizontally connected to the outlet chamber. The afterburning chamber leads to a vertical radiation recuperator which is at the same time part of the stack. It serves for preheating of the major part of the combustion air. The outlet chamber is equipped with a burner for warming both the outlet chamber and the afterburning chamber to 800 C prior to operation of the burner in the melting chamber. Through this measure, incompletely deodorized gases are prevented from leaving the furnace. The combustion of the furnace is rather complete. Analyses yielded a concentration of combustible matter in the end product of only 0.1 wt%, a moisture content of 0.23 wt%, a pH of 6.9, and bulk weight of 2 t/cu m. The unclean flue gases carry very little dust, between 80 and 120 mg/cu m at 7% CO2. The NOx fraction of the flue gases was 55 mg/cu m. Sewage sludge can be burned in the furnace as well.

**33600** **APTIC NO. 56909**

Endell, Norbert

THE WAY TO CLEAN AIR MAINTENANCE ASSIGNED. *(Der Weg zur Luftreinhaltung ist vorgezeichnet). Text in German. Umwelt (Duesseldorf), no. 5:32, 34, Oct.-Nov. 1973. 2 refs.*

The necessity of heavy-duty air pollution measuring processes and instruments is emphasized, and procedures and equipment for the separation of respirable dust are described. Continuous monitoring of air pollution is necessary, especially in pollution-prone industrial areas. Dust measurements revealed decrease in the dust fall, but steady increase in the respirable dust concentrations during the last years. Such dusts should be captured where they are generated, which is possible by large-size dry type, and especially wet type, electrostatic precipitators. Fiber and tissue filters, the latter giving way to the former, are also suitable for the separation of respirable dusts in industries.

**33601** **APTIC NO. 56868**

Engdahl, Richard B., Joseph M. Genco, and Harvey S. Rosenberg

STATE-OF-THE-ART FOR SO2 CONTROL FOR COAL-FIRED POWER PLANTS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E39-E41. 2 refs.*

The situation regarding the control of sulfur dioxide emissions from coal-fired power plants is discussed. In the United States, various technical processes in various stages of development are available for removing SO2 from flue gases. One such process, limestone/lime scrubbing, is a throwaway process which utilizes a relatively cheap raw material; this process is plagued by a number of problems, including plugging of the scrubber circuit, limestone blinding, and difficulty in dewatering the sludge. Magnesia scrubbing offers the advantages of minimal solid waste disposal problems, no water pollution, and a potential credit from the sale of acid. However, the process is susceptible to problems from fly ash and sulfate buildup in the system and possible loss of reactivity of the recycled magnesium oxide. The sulfite-bisulfite scrubbing method offers the advantage of simplicity of operation, along with the disadvantage of sensitivity to the buildup of contaminants. Despite encouraging results with the catalytic oxidation method, the sulfuric acid which is produced may present problems with disposal. The economics of the various flue gas desulfurization processes are considered. It is unlikely that the U. S. utilities can meet the 1975 deadlines for compliance with Federal and state SO2 emission regulations without shifting to gas, oil, or low-sulfur coal.

**33602** **APTIC NO. 56644**

England, Christopher and John Houseman

NOX REDUCTION TECHNIQUES IN PULVERIZED COAL COMBUSTION. *Environmental Protection Agency, Research Triangle Park, N. C., Proc. Coal Combust. Semin., Research Triangle Park, N. C., 1973, p. 173-190. 6 refs. (June 19-20.)*

NTIS: PB 224210/AS

Results of nitrogen oxide reduction techniques for pulverized coal-fired utility boilers are presented. Air-fuel ratio and air preheat (both primary and secondary) were varied routinely and independently in a prefired tubular furnace to determine their effects on NOx production. The level of NOx for constant air flow increased steadily from 160 ppm at an equivalence ratio of 0.5 (200% theoretical air) to a maximum of 1160 ppm at an equivalence ratio of 1.8 (56% theoretical air). The level of NOx on a reduced basis was relatively low in the very lean flames but approached a steady value of about 650 ppm between equivalence ratios of 0.9-1.8. Secondary air preheat had a strong influence on NOx in very air-rich flames, with NOx levels at an equivalence ratio of 0.5 ranging from 450 ppm without preheat to 1250 with 343 C preheat. All NOx equivalence ratio profiles, however, converged on the 650 ppm level in fuel rich flames. The effect of furnace wall temperature was greater at the lean conditions than at stoichiometric conditions, probably due to the lesser heat release rate at the lean conditions.

**33603** **APTIC NO. 56574**

First, Melvin W.

CONTROL OF ACRYLIC ODORS IN PROCESSING INDUSTRIES. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E112-E114.*

Effective odor control methods are outlined for the manufacture of acrylic latexes and for acrylic latex curing. All of the vented vapor and vapor-laden emulsions from the manufacturing process must be gathered into a single exhaust ventilating system and treated by a high efficiency gas-cleaning device prior to release to the atmosphere in order to avoid community odor nuisance. Adsorption on activated charcoal is effective until the bed becomes saturated; concentration of the gases from the reactor is so great that charcoal life is only a small number of hours. Gas incineration is capable of totally reducing acrylate compounds to carbon dioxide and water vapor, provided the temperature is high enough and the retention time at temperature is sufficiently prolonged. Less costly is caustic scrubbing; design of an absorber must take into account the solubility of the vapors in water and the reaction time required to saponify acrylate compounds in caustic solution. A complete odor control system utilizing a caustic absorption tower is schematically depicted. Effectiveness and economy make product modification the preferred route to odor control in the application of acrylic emulsions to fabrics. Great reductions in the volatile acrylate content of latex coatings, to the point of almost complete deodorization, may be obtained by processing and compounding modifications such as selecting ethyl acrylate raw materials prepared by processes which leave a minimum of odorous side reaction impurities in the product, reducing the volatile content of the product by treatment after formulation with low pressure extraction, and suppressing the remaining volatiles by addition of redox catalyst systems which promote polymerization of low molecular weight compound.

**33604** **APTIC NO. 56917**

Flemming, Bohumil, Jaroslav Beranek, and Josef Vejovda

RESEARCH AND DEVELOPMENT IN CZECHOSLOVAKIA OF SULPHUR REMOVAL FROM BOILER FLUE GAS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E42-E44. refs.*

Research and development in Czechoslovakia regarding the removal of sulfur dioxide from thermal power and heating plant emissions is discussed. Wet ammonia methods have been in the forefront of Czechoslovak research over the last few years. However, since these methods were costly, unsuitable for broad application, and unsatisfactory in terms of effectiveness and operational safety, this research was discontinued. Research efforts were then turned to the Sulfacid method, which would be most suitable if the usability of the sulfuric acid produced was confirmed, but no conclusions have yet been drawn regarding this problem. Other methods which are under investigation are the dry limestone method, flue gas scrubbing in caustic sludges, and sulfur removal during fluidized bed combustion. In addition, Czechoslovakia is cooperating with Poland in verifying the dry ammonia method, and with the Soviet Union in studying the wet magnesite method.

**33605** **APTIC NO. 56823**

Fujii, T.

LOW SULFUR FUEL OIL PRODUCTION CENTERING AROUND DIRECT DESULFURIZATION. *(Chokusetsu datsuryu-ho o chushin to suru teiiou nenryoyu seizo no kanosei). Text in Japanese. Sekiyu Gakkai-shi (J. Japan Petroleum Inst., Tokyo), 16(10):829-833, Oct. 1973. 8 refs.*

Direct desulfurization of fuel oil by hydrogenation is discussed. Although oil with 0% sulfur may be obtained theoretically, the present plants give 1% sulfur oil and pilot plants give 0.3-0.5% oil. A process has been developed in which a high desulfurization catalyst and a catalyst which allows for metals work together to lengthen catalyst life by reducing the injurious action of metals. When 0.1% sulfur oil is to be produced, four systems might be considered. First hydrogenation with more catalyst gives a sulfur content of 0.1%. In the second process, hydrogenation desulfurizes the oil to 0.3%, the oil is distilled and desulfurized further by hydrogenation, and it is then passed through a deasphalt process. Third, this process repeats without the deasphalt procedure. Fourth the system is combined with a catalytic cracking system. The first case is cheaper than the other cases.

**33606** **APTIC NO. 56809**

Galeano, Sergio F.

RESULTS OF THE FIRST COMMERCIAL USE OF MOLECULAR OXYGEN FOR ODOR CONTROL IN A KRAFT PULP MILL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E60-E62. 3 refs.*

The use of molecular oxygen for the black liquor oxidation (MOBLO) system for the control of odors from the kraft pulping process is discussed. Practical operating experience with an installation at Orange, Ohio indicates that: operationally, a two-stage oxidation system is required to achieve the highest conversion level; reversion does not occur in the oxidized weak liquor but does occur in the strong liquor either after being oxidized while strong, or when it was previously oxidized while weak: and the MOBLO system allows for immediate flexibility in coping with the reversion problem since the second stage can be located in the pipeline directed to the cascade evaporator or wet precipitator.

**33607** **APTIC NO. 56433**

Garrett, David and T. O. Wentworth

METHYL-FUEL A NEW CLEAN SOURCE OF ENERGY. *Preprint, American Chemical Society, Washington, D. C., 23p., 1973. 8 refs. (Presented at the American Chemical Society, Annual Meeting, Aug. 27, 1973, Paper 9.)*

The environmental impact, application, and economics of methyl- fuel are described. In pilot plant and full-scale power boiler combustion demonstrations there was no evidence of particulate or sulfur compounds. Carbon monoxide and nitrogen oxides were less than in oil and gas, soot was burned off, and aldehydes, acids, and unburned hydrocarbons were negligible. Methyl fuel can be used as a boiler fuel, gas turbine fuel, gasoline additive, in waste water treatment, as a feedstock for substitute natural gas, in fuel cells, and in processes requiring ample hydrogen. An economic evaluation has led to an estimated capital cost for a commercial methyl fuel plant ranging from $154 MM upwards, depending upon site conditions, offsites, and utilities plant requirements.

**33608** **APTIC NO. 56776**

Greco, Joseph

ELECTROSTATIC PRECIPITATORS--AN OPERATOR S VIEW. *Air Pollution Control Assoc., Pittsburgh, Pa., Proc. Spec. Conf. Des. Oper. Maint. High Effic. Contr. Equip., St. Louis, Mo., 1973, p. 53-69. (March 29-30.)*

The operating performance and reliability experience of the electrostatic precipitators installed on 51 generating units, ranging in size from 60 to 1300 MW in the Tennessee Valley Authority (TVA) system during the past 15 years are summarized. Operating experience and performance tests on the early units have resulted in significant changes in the specifications for the more recent units. These include a more conservatively specified gas flow, a reduction in face velocity from 8 to 4 ft/sec, flow distribution model studies, and the actual gas temperature operating range. Data are presented to show the effect of gas temperature on electrostatic precipitator performance while operating on medium and high-sulfur coals. This data indicate poor performance with the low sulfur coal at the higher gas temperature and the high-S coal at the lower gas temperature. Performance on the medium-S coal is almost constant over the entire operating temperature range. Electrostatic precipitators operating at low gas temperatures on high-S coals require very high TVA ratings to achieve optimum voltage levels. Those operating at high gas temperatures on low-S coals operating at less than the optimum performance level because of the relatively low power levels that are the result of high sparking activity. Reliability data are presented which show electrostatic precipitator section outages that have resulted from failures of various components of the precipitators. Although unsatisfactory performance has been experienced on some TVA collectors because of inadequate definition of the requirement and unfavorable reliability experience, successful installations are economically attainable. These require a realistic definition of the requirement, proper design and construction, and adequate operation and maintenance. (Author abstract modified)

**33609** **APTIC NO. 56530**

Haga, Tatsuro

METHOD AND DEVICE DESIGNED TO DISPOSE OF CRUDE AND HEAVY OIL COMBUSTION SOOTS. *(Gen juyu nensho susu no shori no tameno hoho narabini sochi). Text in Japanese. (Toden Flyash Industry Co., Ltd., Tokyo (Japan)) Japan. Pat. Sho 48-32076. 8p., Oct. 3, 1973. (Appl. Oct. 25, 1969, 2 claims).*

Soot from thermal power plants can be collected and useful substances recovered by the addition of calcium carbonate to the soot. Water is then added and the sulfuric acid content of the soot is reduced to calcium sulfate. Since the ash obtained by burning the soot now containing CaSO4 contains useful elements such as metals, the ash can be supplied to a metallurgical process as a fine ore material, or making use of the calcium sulfate it contains, may be used as a raw material to manufacture lightweight aggregate or construction material. Carbon dioxide produced during formation of CaSO4 can be recovered as carbonic acid; gases produced when obtaining the ash are used to preheat the device and are then treated to render them harmless.

**33610** **APTIC NO. 56307**

Hanan, Joe J.

ETHYLENE POLLUTION FROM COMBUSTION IN GREENHOUSES. *HortScience, 8(1):23-24, Feb. 1973. 8 refs.*

Ethylene is a by-product of combustion, regardless of precautions taken to ensure complete burning. To avoid crop damage in greenhouses where burning is used to supply carbon dioxide, flue gases must be diluted. Tests in different greenhouses in the Denver region showed that ethylene may reach significant levels in flue gases from large unit heaters vented into the house unless the unit is equipped with a distribution tube to force complete air recirculation, bringing fresh air to the burner. The free air entry for combustion should be double the National Fire Protection Code requirements of ca. 1 sq cm 200/kcal/hr (1 sq in./5000 Btu/hr input), and specific provision should be made in the greenhouse structure for combustion air entry. (Author abstract)

**33611** **APTIC NO. 56539**

Hansen, W.

BALANCE ON THE HEATING SECTOR. *(Bilanz im Heizungswesen). Text in German. Oel. Gasfeuerung, 18(12):908-917, 1973. 17 refs.*

An outline of the numerous developments in progress concerning the combustion and emission problems encountered with oil-heaters is given. Present developments aim at the improvement of the combustion, the application of multi-substance burners, gasification, and the application of auxiliary agents such as atomized water for the reduction of emissions. The combustion process can be improved by better mixing of fuel with air ahead of the burner nozzle and by controlling the reaction processes within the flame. The means for better mixing are blower pressure, atomization characteristics, and flow distribution ahead of or in the burner nozzle. Combustors or gasification burners provide for a longer residence time of the combustible matter. At sufficiently high temperature and water injection, the developing water vapor dissociates. The liberated oxygen oxidizes soot particles to carbon oxides. Apart from a reduction of the soot emission, the oxides of nitrogen emission can be reduced through combustion with less excess air.

**33612** **APTIC NO. 56540**

Hashimoto, Naoto

SEMI-WET TYPE FLUE GAS DESULFURIZER AND DESULFURIZATION BY ACTIVATED CARBON. *(Hanshisshiki oyobi kasseitanho haien datsuryuho ni tsuite). Text in Japanese. Kogai Boshi Netsu Kanri Hokkaido (Hokkaido Assoc. Energy Pollut. Contr.), 26(86):15-18, Sept. 1973.*

Two pilot plants were set up to study the activated carbon adsorption of sulfur dioxide from flue gas. Wet flue gas desulfurization has been studied separately in a pilot plant. An activated carbon desulfurization plant capable of treating 420,000 N cu m/hr flue gas was completed in Sept. 1972. The SO2 is converted to sulfuric acid which can be recovered, and the carbon is washed and reused. The adsorption capacity of the carbon is lowered after passage of flue gas, but eventually reaches a steady value after 1500-2000 hours. Desulfurization rate is 80-90%, by-product recovery of H2SO4 is 65%. A semi-wet desulfurizer capable of treating 25,000 N cu m/hr of gas was constructed using caustic soda as the absorbent. The desulfurization rate is 80% at 180 C.

**33613** **APTIC NO. 56819**

Hirasawa, Shinzo

MEASURES FOR PREVENTING NITROGEN OXIDES EXHAUSTION BY FIXED SOURCES. *(Kotei hasseigen ni okeru NOx taisaku). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 9(9):888-898, Sept. 1973. 6 refs.*

Emission standards for nitrogen oxides from stationary sources were set in Japan on Aug. 10, 1973. They require industry to reduce NOx pollution by 20-40%. Methods to reduce NOx from furnaces include improvement of the burner, addition of steam, reduction of nitrogen in fuel, and improvement of combustion conditions. The NOx can be removed from exhaust gases by reduction, adsorption, and absorption.

**33614** **APTIC NO. 56902**

Horowitz, Joel

COST-EFFECTIVENESS ANALYSIS OF ALTERNATIVE STRATEGIES FOR REDUCING EMISSIONS FROM MOTOR VEHICLES. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. F35-F36. 9 refs.*

The work trip is responsible for about 40% of the automobile vehicle miles traveled in U. S. cities and the largest single generator of automobile travel. If rapid bus service, with stops close to the traveler s desired points of origin and destination were provided at reasonable cost, considerable reductions in automobile work trips could probably be achieved. Further, the reduction in automobile work trips achievable through mass transit improvements may be substantially augmented as a cost penalty is imposed on automobile use. Provided the transit travel time exceeds the automobile travel time by only 15 minutes and a $2.25 automobile penalty were imposed, a 38% reduction in both hydrocarbon and carbon monoxide emissions from automobiles could be achieved. These reductions appear to be available at a net cost saving relative to continued automobile operation if suitable transit load factors can be attained. Further study should be devoted to the problem of achieving high load factors which maintain acceptable service levels over large portions of urban areas, and to clarifying the relationships between transit service, transit ridership, and automobile ownership.

**33615** **APTIC NO. 56498**

Inaba, Hideya

NOX REMOVAL BY THE CATALYTIC REDUCTION METHOD. *(Sesshoku kangenho ni yoru NOX no jokyo). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(10):1111-1115, Oct. 1973.*

An improved catalyst for reducing nitrogen oxides by reduction was developed which generated no ammonia. The catalyst does not contain any precious metal, is easy to produce, and is economical. In the presence of the catalyst, excess carbon monoxide reacts with water to become carbon dioxide, so no secondary pollution by CO occurs except when the reaction temperature is much lower than the water soluble gas reaction temperature. If air is introduced after the reaction, CO is easily turned into CO2. Optimum reaction temperature is 400-450 C. Manganese ferrite is used to absorb sulfur dioxide. A pilot plant with 10,000 N cu m/hr capacity was constructed. Several improved catalysts are discussed.

**33616** **APTIC NO. 56526**

Inagaki, Kineo

ABSORBENTS AND ADSORBENTS FOR BAD ODOR PREVENTION AND THEIR PROBLEMS. *(Akushu boshi ni okeru kyushu, kyuchakuzai no genjo to mondaiten). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(9):1049-1054, Sept. 1973. 4 refs.*

Adsorption can remove dilute gases such as odors. Typical adsorbents include activated carbon, silica gel, alumina gel, and activated clay. When activated carbon is used as the deodorant for organic gases, the higher the boiling point of the gas, the greater the adsorption. Adsorption ranges from 40 to 10%. Sulfonated carbon obtained from the reaction of coal and sulfuric acid is excellent in the adsorption of alkaline gases, but once the sulfonated carbon is treated with caustic soda or soda ash, it begins to adsorb acid gases and can remove chlorine and ozone. The LMN adsorbs hydrogen sulfide, acetic acid, and butyric acid, but the reaction with organic sulfur compounds such as mercaptans is slow.

**33617** **APTIC NO. 56883**

Inagaki, Kineo

NOX PREVENTION TECHNOLOGY BY THE CONTACT OXIDATION METHOD. *(Sesshoku sankaho ni yoru NOx no jokyo gijutsu). Text in Japanese. Kemikaru Enjiniyaringu (Chem Eng.), 18(10):1123-1128, Oct. 1973. 27 refs.*

Oxides of nitrogen and sulfur in odorous stack gases are removed by catalytic oxidation and reduction. Various catalysts also allow by-product recovery. Special ceramics which are heat-proof, acid-proof, and alkali-proof can be recovered. Activated charcoal is the most effective catalyst bearer. The waste gases must contain at least 10% water. Optimum NOx removal occurs at 100-150 C, but it is possible to get good results at as low a temperature as 90 C, depending on the catalyst used. After 4 sec contact with 182-306 ppm NOx, removal efficiency was 83.3-93.9%. At 2 sec contact, over 98% desulfurization of 1000-1100 ppm SOx occurred. It is possible to recover nitric acid and sulfuric acid.

**33618** **APTIC NO. 96925**

Ishihara, T.

ANTI-NOX MEASURES FOR INDUSTRIAL BOILERS. *(Sangyo yo boila no NOX taisaku). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 40(11):1085-1090, Nov. 1973.*

Nitrogen oxides control for industrial boilers is reviewed. A suitable burner can reduce NOx 20-30%. A higher temperature for the preheated air increases the NOx emissions. Both excess air and insufficient air are not successful. Complete combustion is achieved by two-stage combustion, which blows additional air into the center of the furnace and reduces local temperatures.

**33619** **APTIC NO. 56953**

Janczewski, Henryk

A CITY WITHOUT SMOKE. *(Miasto bez dymu). Text in Polish. Gaz, Woda Tech. Sanit. (Warsaw), 47(8):251-254, 1973.*

The Icelandic city of Reykjavik, its clean atmosphere, and geothermal heating system, are described. Volcanic eruptions and the abundance of hot subterranean waters in Iceland enabled the municipal authorities to transform formerly heavily polluted cities into cities with clean air. Drilling put at the disposal of the inhabitants huge quantities of hot water, its temperature varying between 87 C and 128 C. The flow capacity varies between 220 gal/min and 5400 gal/min. Three types of pumps are being used: deep sea pumps, pumps supplementing the pressure in the main thermal area, and the pumps at the area stations. The first are located in openings at a 110 to 120 m depth, i.e., 360 to 400 ft, and are electrically operated. After utilizing the hot water for the city s heating, the water left has the low temperature of 25 to 30 C and this water is used for swimming pools, hothouses, and laundry facilities. The savings achieved through this heating system exceed 50% as compared to oil and the cheapest electrical heating. The water from the geysers is very healthful due to the fact that it contains no bacteria, and therefore no chloride must be added to drinking water. Dissolved substances reach only 70 mg in Reykjavik. The water contains the recommended quantity of fluoride for healthy teeth, and approximately 20 cu cm/l gases, among them, nitrogen. There is no oxygen in the water. Traditional heating with oil in domestic burners would have emitted approximately 2000 tons of sulfur dioxide, 850 tons nitrogen, and 210 tons of ashes and soot. Drilling with modern equipment is investigating new possibilities of geyser exploitation. Deep sea drillings at Reykir, Krysuvik, Reykjanes, and Nesajavellir at 1400 to 1600 m indicated that the Icelandic islands possess unlimited sources of hot water underground.

**33620** **APTIC NO. 56618**

Kahnwald, Helmut, Hans Wilhelm Kreutzer, and Dirk Marchand

DUST AND GAS PRODUCTION DURING ELECTRIC STEEL MANUFACTURING, AND POSSIBILITIES OF EMISSION ABATEMENT BY MEANS OF APPROPRIATE CAPTURE AND DUST SEPARATION SYSTEMS. *(Staub- und Gasanfall bei der Elektrostahlerzeugung und Moeglichkeiten zur Emissionsverminderung durch geeignete Erfassungs- und Entstaubungssysteme). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E3-E7.*

Possibilities of waste gas capture and dust separation in electric steel production processes are described. Direct, side-draft, and roof hood suction of the flue gases are the basic possibilities of waste gas capture in electric steel smelting plants. Nearly quantitative capture of the dust emissions is possible by means of the roof hood suction system. While wet type electrostatic precipitators, dry type electrostatic precipitators, Pease Anthony venturi scrubbers, and disintegrators are equally suitable for dust separation in electric steel smelting plants, tissue filters have been increasingly used for such purposes due to more exacting separation requirements, the need for the recovery of valuable dust components, and problems involved in the disposal of separated dust. Filter tissues made of polyacrylnitrile withstand temperatures up to 140 C in slightly acid and slightly alkaline media. The required flue gas temperature can be achieved by additional cooling system, or the admission of fresh air. The unit capacity of tissue filters is 0.8-1.1 cu m/min and sq m. Combinations of roof hood suction systems with bag filters, and of direct suction with bag filters have overall dust separation efficiencies of 95% and 87%, respectively.

**33621** **APTIC NO. 56561**

Kasaoka, Narimitsu, Eiji Sasaoka, and Kenji Tanaka

MATERIAL DIFFUSION AND CATALYTIC EFFECTS IN ADSORPTION. *(Kyuchaku ni okeru busshitsu kakusan to shokubai koka ni tsuite). Text in Japanese. Preprint, Japan Society of Chemical Engineers, Tokyo, p. 29-32, 1973. 3 refs. (Presented at the Japan Society of Chemical Engineers, Symposium on Adsorption and Reaction, Tokyo, Japan Sept. 3, 1973.)*

The crust-like interface progress model in spherical solids has been extended to cylindrical adsorbents, and the rate equation has been derived. Colored bivalent ionic solutions were adsorbed on cyclindrical gamma-alumina pellets, and the progress of the colored section was followed as a function of time. The interface proceeded as a reactangular crust in the axial cross section. Assuming that the progress of the interface in the axial direction is independent of the progress in the radial direction, the rate equation was developed for adsorption on cyclindrical solids. The liquid phase adsorption results showed a good agreement with the equation, being independent of adsorption temperature between 25 and 75 C. However, vapor phase adsorption of sulfur dioxide and nitrogen dioxide on activated charcoal resulted in only a partial agreement with the equation. Moreover, effects of catalyst and pretreatment of activated charcoal on adsorption of SO2 oxygen-water-nitrogen and nitric acid-O2-H2O-N2 were investigated. Incorporation of oxidation catalysts and 900 C activation resulted higher adsorption rate. The rate and amount of adsorption can be largely enhanced by changing the structure and distribution of micropores and surface of adsorbents.

**33622** **APTIC NO. 56527**

Kato, Seitaro

REMOVAL TECHNIQUES FOR NOX IN FACTORY EXHAUST GAS AND THEIR PROBLEMS. *(Kojo haigasuchu no sankachisso no jokyo gijutsu no genjo to mondaiten). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(10):1086-1101, Oct. 1973. 45 refs.*

Nitrogen oxides in stack gases can be removed by catalytic oxidation; absorption; wet treatment with caustic soda, magnesium hydroxide, chlorine and ammonia, ferrous sulfate, and other chemicals; adsorption on silica, alumina, alkaline carbonates, metals, molecular sieves, activated carbon, ion exchange resins, and metals; catalytic thermal decomposition; and catalytic reduction using carbon monoxide, and hydrogen sulfide. Sulfur dioxide and nitrogen dioxide can be removed at the same time by several methods.

**33623** **APTIC NO. 56619**

Kawasaki, Hideo

A WET TYPE NITROGEN OXIDES ELIMINATING METHOD, THE NE PROCESS. *(Chisso sankabutsu no shisshiki jokyoho NE purosesu). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(6):651-656, June 1973. 19 refs.*

The NE process is a wet type nitrogen oxides control process developed by Nissan Engineering Ltd. aiming at the fact that the oxidation and absorption method has the best eliminating efficiency for removing NOx in the presence of oxygen. The running cost can be reduced by the recovery of the oxidation absorbent (an alkaline solution of potassium permanganate). In the NE process, the exhaust gas containing nitric oxide and nitrogen dioxide is washed with the excess liquid from the alkali absorption tower and the NE absorption tower and water at the washing tower. In this case, NO is reacted with potassium permanganate and sodium hydroxide to form manganese nitrite, potassium nitrite, and sodium nitrite; NO2 is converted into nitric acid; and NO, NO2, and sodium hydroxide form sodium nitrite. The manganese in the excess liquid from the washing tower can be removed when filtered at more than pH 9, and thus the disposal of the waste water is no problem. At the alkali absorption tower, 70 to 80% of the NO2 can be removed. In the NE absorption tower, a slight excess of alkali and potassium permanganate are added so that the final manganese salt has a six valence, and a high absorption efficiency is kept.

**33624** **APTIC NO. 56907**

Kirpichev, V. S.

ALUMINUM-CHROMIUM CATALYST FOR THE INCINERATION OF HARMFUL ORGANIC COMPONENTS IN FLUE GASES. *(Alyumokhromovyy katalizator dlya dozhiganiya vrednykh organicheskikh primesey v vybrosnykh gazakh). Text in Russian. Khim. Tekhnol., no. 4:15-16, 1973. 10 refs.*

The catalytic efficiency of oxides of cobalt, copper, nickel, chromium, and aluminum, as well as of their binary mixtures, was studied with respect to the catalytic oxidation of organic waste gas components, such as methane and toluene. The catalysts were prepared by imbibing the catalyst support with aqueous solutions of the nitrates of the respective metals and subsequent heating at 400 C. The Al-Co catalyst excelled at high activity and high resistance to overheating, while the other catalysts lost a considerable proportion of their activity as a result of overheating. High efficiency of the catalytic oxidation of methane by means of the Al-Co catalyst at 350 C and a space velocity of 5000/h was determined. No decrease in the activity after 500 hr operation was noted. The Al-Co catalyst was used in the form of cyclinders of 4-6 mm in diameter and 4-25 mm in length, with a specific surface of 160 sq m/g.

**33625** **APTIC NO. 56769**

Klodt, Donald T.

CORROSION OF AIR POLLUTION CONTROL EQUIPMENT IN THE MINERAL INDUSTRIES. *Mineral Industries Bulletin, 16(1):1-14, 1973. 58 refs.*

A general overview of the corrosion problems and resultant high cost associated with the operation of air pollution control equipment in the mineral industry is presented. Four classes of dust and mist collectors are used in the mineral industry: mechanical collectors; cloth or fabric collectors; liquid scrubbers; and electrostatic precipitators. Evaporative coolers are sometimes used in conjunction with these devices. A major operation problem with air pollution control equipment is the failure or deterioration of metallic structures or components due to corrosion. This problem is discussed as it relates to electrostatic precipitators, scrubbers, and mechanical collectors. Corrosion losses of metals and alloys and the preventive measures taken to reduce or eliminate the corrosion problems amount to at least $10 billion each year in the United States; more accurate and reliable cost data on air pollution control processes and equipment are needed. Recent corrosion research is briefly summarized, and case histories are presented of corrosion in sulfuric acid plants, corrosion of an electrostatic precipitator on a basic oxygen steelmaking furnace, corrosion of a gas scrubber, stress corrosion of induction fans, and corrosion fatigue of cooling tower fans. Steps to overcome or mitigate corrosion include: the evaluation of construction materials used in corrosive environments; environmental control, including temperature and pH control; periodic cleaning of equipment and the removal of contaminants from scrubbing waters; the conduction of corrosion test programs on a continuing basis throughout the operating life of the equipment; and periodic detailed inspections of equipment and complete examinations of equipment items removed from service. Appended is a brief review of corrosion, with emphasis on aqueous versus dry corrosion, corrosion attack, the rate of attack, intergranular corrosion, corrosion fatigue, galvanic or dissimilar metal corrosion, and some of the common forms of corrosion.

**33626** **APTIC NO. 56333**

Kranich, W. L., Y. H. Ma, L. B. Sand, and I. Zwiebel

REMOVAL OF SO2 AND NOX BY MOLECULAR SIEVE ZEOLITES. *Preprint, American Chemical Society, Washington, D. C., 12p., 1973. (Presented at the American Chemical Society, National Meeting, 166th, Chicago, Ill., Aug. 26-31, 1973, Paper 61.)*

The feasibility of treatment of stack gases by coadsorption of sulfur dioxide and nitrogen oxides on molecular sieve zeolites is discussed. Because of possible complex interactions among the adsorbable components of stack gases, a brief study was made of adsorption of mixed gases. A mixture of SO2, nitrogen dioxide, and water in inert gas carrier was adsorbed on H-mordenite, natural mordenite, and AW-300. After equilibrium was reached at 60-70 C the adsorbents were regenerated either by heating to 250 C or by evacuation at the sorption temperature. In each case the adsorbent was restored essentially to its original weight, strongly suggesting complete regeneration and restoration of capacity. Sulfur dioxide in helium and two sorbate gas mixtures in helium were passed through a natural mordenite bed. When a mixture of SO2 and NO2 of the same concentration of total active sorbate in helium as was contained in an SO2 feed was passed through the bed, the breakthrough time was only moderately reduced. The NO2 and SO2 broke through at approximately the same time. Addition of nitric oxide to the sorbate mixture markedly decreased the breakthrough time for NOx presumable because of the limited and slow sorption of NO previously demonstrated. These results were qualitatively confirmed in a laboratory. A preliminary study of methods of recovery of the gases and regeneration of the adsorbent was conducted based on desorbing the oxides using heat. The process is technically feasible. Costs are high, but rough projections indicate that they are generally comparable to other processes now under active consideration. Costs are strongly dependent upon the price and life of sorbents.

**33627** **APTIC NO. 569277**

Kumagaya, M.

TECHNIQUES FOR LOW SULFUR HEAVY OIL PRODUCTION. *(Tei ion juyu no seizo gijutsu). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 40(11):1101-1110, Nov. 1973.*

Direct desulfurization, indirect desulfurization, cracking processes, and gasification are used for the desulfurization of heavy oils. The direct desulfurization process involves catalytic hydrogenation which is often disrupted by the asphaltene component. Indirect desulfurization avoids this problem but the overall desulfurization ratio is decreased. Gasification involves partial oxidation and flexicoking. The direct process with topped crude oil is economical when the desulfurization limit is 0.5% sulfur content. Gasification may be combined with the indirect process, although the initial cost and circumstances of the user must be considered.

**33628** **APTIC NO. 56822**

Kunii, D. and T. Kunugi

PRODUCTION OF OLEFINS BY THERMAL CRACKING OF HEAVY OILS THROUGH A FLUIDIZED BED OF CIRCULATING COKE PARTICLES. *(Kokusu netsubaitai junkan ryudoso ni yoru jushitsuyu yori olefin no seizo ho). Text in Japanese. Sekiyu Gakkai-shi (J. Japan Petroleum Inst., Tokyo), 16(10):834-838, Oct. 1973. 6 refs.*

The production of olefins from crude oil or residual oil was tested. The process can produce low sulfur oil or water gas. The feed stream is flown into a reaction tower with steam and decomposed in a fluidized bed. High temperature gas is produced by burning residuals formed on the surface of the coke during cracking. This process may be more profitable than conventional cracking. The residence time of the feed stream in the reactor should be increased to give water gas; this would produce a 4000-8000 kcal fuel gas. Petroleum coke may be treated by this process.

**33629** **APTIC NO. 56870**

Lindau, Lars

AIR POLLUTION AND THE FERRO-ALLOY INDUSTRY. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E8-E10. 3 refs.*

In Sweden, there is a permit system for polluting industries, including the ferroalloys industry, and an effective supervision system. There are also recommendations for measures to restrict the emissions from plants causing air pollution. Up to now, the ferroalloys industry has been granted about 2 million dollars by the Swedish government for investments in pollution reduction measures of about 6 million dollars. The Swedish ferroalloys industry emits large amounts of particulates, chromium, and manganese; rather low concentrations of sulfur dioxide have been measured, in spite of high emissions, due to reactions in the atmosphere between dust and SO2 to produce sulfate. Semi-closed furnaces equipped with boilers can be used in the production of ferrosilicon and silicomanganese, and this furnace is highly desirable in terms of air pollution reductions. High-pressure wet collectors provide efficient dust collection for closed furnaces, while electrostatic precipitators, fabric filters, and gravel bed filters have been used with open and semi-closed furnaces. The costs of collector installation and open and semi closed furnaces are high. Although the Swedish government has set limits on sulfur dioxide emissions, the bisulfite method, which has been proposed for removing SO2 from the flue gases of ferroalloys plants, is so expensive that the process has not yet been commercially adopted. The furnace dust which is collected is commonly deposited, although many different applications for it have been suggested.

**33630** **APTIC NO. 56516**

Lindvall, Thomas, Olle Noren, and Lennart Thyselius

ON THE ABATEMENT OF ANIMAL MANURE ODOURS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E120-E123. 10 refs.*

Results of investigations aimed at determining the efficiency of different methods of odor control in the handling and spread of pig manure are presented. Measurements were made in a mobile odor laboratory, and an estimation was made of the amount of dilution of the odorous gas with air necessary to attain odorlessness in 50% of the observations. Addition of ammonium persulfate prior to the spread resulted in odor reduction by about a power of ten (odor threshold values). Manure that was continuously aerated for 3 and one-half months gave rise to less intense odors than the untreated manure, but the effect varied between laboratory and field conditions. All methods of burying manure reduced odor strength by one or two powers of ten, and best results were obtained by using a special subsurface manure injection technique which reduced the odor to background level. Reduction by atmospheric dilution was measured, and it was found that odor connected with subsurface injection leveled off within 200 m to background levels; odor caused by surface spread was perceived five to 10 times stronger even at 400 m.

**33631** **APTIC NO. 56434**

Major, Robert L.

THE FUELS AND ENERGY SITUATION IN THE MIDWEST INDUSTRIAL MARKET. *Preprint, Purdue Univ., Lafayette, Ind., 29p., 1973. 62 refs. (Presented at the Industrial Fuel Conference, Layfayette, Ind., Oct. 3-4, 1973.)*

The desulfurization of coal is reviewed in a discussion on the availability of fuels in the midwestern industrial area. Although the midwestern region has abundant coal, practically all the coal is too high in sulfur to comply with current or proposed air quality standards regarding sulfur oxides emissions. Continued use of coal is possible only if one or more of the following desulfurization methods can be used: the perfection of technically feasible and economically competitive flue gas desulfurization devices and their installation on boiler units; the conversion of boilers to burn western low S coals, providing that supplies of such coal can be secured; the chemical removal of the S in the coal by means of solvent refining techniques; conversion of the coal into low S gas or liquid fuels; and relaxation of standards to allow episodic or intermittent control to maintain air quality at ground level. Low S coal and flue gas desulfurization devices are the most promising. (Author conclusions modified)

**33632** **APTIC NO. 56951**

Masui, Yoshio, Makoto Nakazawa, Yoshio Saiki, Yasuji Himi, and Saburo Kanno

THE RELATION OF IGNITION TIME AND NOXIOUS COMPONENTS CONCENTRATION IN EXHAUST GAS. *(Tenka jiki chosei ni yoru jidosha haishutsu gasuchu no yugai seibun no henka). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):325, Oct. 1973. (Presented at the Japan. Society of Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 70.)*

The noxious components in automotive engine exhaust gases were checked in relation to spark timing delay and spark timing control device. A 2000 cc domestic car was moved on a chassis dynamometer, and CVS samplings were analyzed for carbon monoxide by non-dispersion infrared analyzer, for nitrogen oxides by chemiluminescence, and for hydrocarbons by flame ionization detector. Nitrogen oxides and HC were reduced by diminishing BTCD degree (ignition gap?), but CO tended to increase when BTCD was between 4 and 8 deg. At the legal standard of BTDC 3 deg. the amount of CO did not fluctuate, but NOx fluctuated zero to 40%, and HC between 2 to 12%, depending on the speed. With the installation of a control system, these reduction rates increased. With a smaller car, the effect of spark time delay was more prominent.

**33633** **APTIC NO. 56825**

Matsudaira, Tadashi and Masayoshi Ichikawa

DISPOSAL OF EXHAUST GAS FROM THE BAKING DRYER ON COIL-COATING LINE. *(Koiru kotengurain ni okeru yakitsuke kansoro no haikishori). Text in Japanese. Toryo no Kenkyu (Study Paint), no. 88:18-24, 1973. 2 refs.*

A baking dryer on a coil-coating line produces solvents, carbon monoxide, nitrogen oxides, aldehydes, odors, smoke, and dust. Organic solvents can be removed by condensation, absorption, adsorption, combustion, and catalytic oxidation. Activated carbon adsorption increases as temperature decreases. Direct combustion oxidizes the exhaust gas for 0.3-0.6 sec at 650-850 C. Catalytic combustion takes place at 200-360 C with platinum as the catalyst.

**33634** **APTIC NO. 56954**

Matsunaga, Naotoshi, Kenkoku Azuma, and Hidetoshi Yoshioka

ELIMINATION OF NO2 BY ADSORBENTS. *(Kyuchakuzai ni yoru NO2 no jokyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):346, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukishima, Japan, Nov. 6-8, 1973, Paper 90.)*

The nitrogen dioxide adsorption efficiency of various adsorbents were examined. The test apparatus is presented by a diagram. The adsorbents tested were 15 mmt and 20 mmt activated carbons, various adsorbent resins, resins with a filter, and an alkaline-soaked adsorbent resin. The results are presented by graphs. In general, the elimination rates of resins were inferior to those of activated carbon, but the alkaline-soaked resin adsorption attained the level of activated carbon when NO2 concentration increased to 1 ppm. For lower concentrations (0.05-0.5), the adsorption rate of alkaline soaked resin was 50% to 90% of that of activated carbon. The best adsorption result was obtained by 4-6 mesh activated carbon.

**33635** **APTIC NO. 56643**

McCann, C. R., J. J. Demeter, and D. Bienstock

PRELIMINARY EVALUATION OF COMBUSTION MODIFICATIONS FOR CONTROL OF POLLUTANT EMISSIONS FROM MULTI-BURNER COAL-FIRED COMBUSTION SYSTEMS. *Environmental Protection Agency, Research Triangle Park, N. C., Proc. Coal Combust. Semin., Research Triangle Park, N. C., 1973, p. 205-213. (June 19-20.)*

NTIS: BP 224210/AS

Preliminary results of combustion modifications for control of pollutant emissions from multi-burner coal-fired combustion systems are presented. Experimentation was conducted in a 500 lb/hr pulverized coal-fired unit whose operation closely simulates industrial practice. Decreasing excess air to about 2% resulted in reduction of oxides of nitrogen from 1.45 gm/million cal (at 20% excess air) to .5 gm/million cal. Nitrogen oxides decreased from about 1.1 gm/million cal when 105% of stoichiometric air was supplied to the first stage of a two-stage combustion unit to .77 gm/million cal when 80% of stoichiometric air was supplied to the first stage. Carbon combustion efficiency was maintained at greater than 98%. Significant reductions also occurred when air was introduced normally to the front and rear walls of the second stage. Recycling of flue gas through the secondary air streams also resulted in a significant reduction of NOx. Carbon monoxide emissions generally ranged from 30-60 ppm for the standard and other tests except those operated at low excess air levels. Ambient and combustion air contained about 2-3 ppm hydrocarbons, and flue gas concentrations were between 0.5-0.8 ppm in tests conducted at 20% excess air levels. Hydrocarbon emissions increased at lower excess air levels. Degree of slagging, noted visually, appeared to be minor.

**33636** **APTIC NO. 56412**

McGlamery, G. G., R. L. Torstrick, J. P. Simpson, and J. F. Phillips, Jr.

CONCEPTUAL DESIGN AND COST STUDY. SULFUR DIOXIDE REMOVAL FROM POWER PLANT STACK GAS. MAGNESIA SCRUBBING - REGENERATION: PRODUCTION OF CONCENTRATED SULFURIC ACID. *Tennessee Valley Authority, Muscle Shoals, Ala., Environmental Protection Agency Interagency Agreement TV-29233A, EPA-R2-73-244, Program Element 1A2013, 386p., May 1973. 100 refs.*

NTIS: PB 222509

A cost and design study into the removal and regeneration of sulfur dioxide from power plant stack gases via magnesia (manganese sulfite) scrubbing was undertaken. The SO2 absorption by magnesia scrubbing is effective and technologically feasible; it is not an effective means of nitrogen oxide removal. Equipment for the process is commercially available, with investment requirements running from 1 to 28% greater than for limestone-wet scrubbing. Achievable net sales revenue for recovered 98% sulfuric acid from the process would probably average $8 to $12 per ton over the next decade. Primary economic factors are investment, product volume, net sales revenue, competitive cost alternatives, and basis of financing. Under total regulated financing, magnesia systems can compete with limestone scrubbing on larger power units; total unregulated industry financing and operation appear unlikely. A cooperative venture between several power companies and a chemical company would be a good way to fund a magnesia system; interest in the process has centered more on the replacement of sulfur as a raw material in existing sulfuric acid plants with existing markets rather than for added capacity to meet increasing acid markets; there are a limited number of locations that can support a central process installation; and for short-range shipping distances (0 to 50 miles), the cost of shipping magnesium sulfate and magnesium oxide between sites is a small part of the total process cost, although shipping cost becomes much more significant as distances exceed 100 miles. Process chemistry, properties, and kinetics are discussed. (Author summary modified)

**33637** **APTIC NO. 56834**

Miller, William C.

GRAY IRON FOUNDRIES WITHOUT CUPOLAS: EMISSION REDUCTION AND OPERATING EXPERIENCE. *VDI-Verlag GmbH, Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E36-E38. 8 refs.*

When Philadelphia revised its particulate emission regulation, the economic viability of the local gray iron foundry industry was threatened in that the cost of the control equipment necessary to reduce emissions from the cupola melting process would have placed an economic burden on the industry, with smaller foundries being forced out of business. Thus, the conversion to a reverberatory furnace was chosen as a viable alternative and the remedy to the problem of air pollution control for the industry. The conversion to a gas-fired reverberatory furnace system has resulted in; the use of more expensive raw materials and fuels; reductions in the production rate, and the increased maintenance of refractory materials. The two basic operational complaints have been short refractory life and low furnace temperatures; the magnitude of these problems appears to increase with the size of the furnace. However, for each foundry, the reverberatory furnace emissions would be less than allowed by the new regulations; the anticipated particulate emission reduction is 50 tons per year for the total industry, plus the elimination of large quantities of carbon monoxide emissions.

**33638** **APTIC NO. 56828**

Minami, H.

VISBREAKING PROCESS. *(Bisubreikingu ho). Text in Japanese. Sekiyu Gakkai-shi (J. Japan Petroleum Inst., Tokyo), 16(10):855-859, Oct. 1973. 14 refs.*

Visbreaking produces low sulfur fuel from heavy fuel oil. It reduces the viscosity of heavy oil as well. The residue from the reduced pressure flashing operation is placed in a visbreaker to decompose. The decomposed gas, naphtha, and visbreaker gas oil are recovered from the top, and visbreaker tar, containing sulfur and heavy metals, is obtained from the bottom. The gasoline obtained has 59-75 octane. The caloric value of the decomposed gas is 1000 kcal/kg. Costs and operating conditions are described.

**33639** **APTIC NO. 56850**

Miyamoto, Noboru and Hiromi Ishitani

EFFECTS EXERTED BY PROPERTIES OF FUEL ON THERMAL EFFICIENCY AND EXHAUST GASES OF A SPARK-FIRING ENGINE. *(Nenryo seijo ga hibanatenka kikan no netsu koritsu narabini haishutsu gasu ni oyobosu eikyo). Text in Japanese. Preprint, Hokkaido Branch of the Japan Soc. of Mechanical Engineers, Sapporo, p. 123-126, 1973. (Presented at the Japan Society of Mechanical Engineers, Hokkaido Branch, Lecture Meeting, 16th, Muroran, Japan, Oct. 7, 1973.)*

Performance characteristics of a spark-fired engine was studied using various types of fuels in order to determine the relationship between the properties of the fuel used and total performance of the engine. Thermal efficiency and emission characteristics were of particular interest. High-octane fuels, regular gasoline, no-lead gasoline, kerosene, heavy oil, and ethyl alcohol were tested on a single-cylinder petroleum-oil engine operated at 2400 rpm with the cooling water temperature at about 100 C and the intake valve set at 1/2. Combustion was investigated with each type of fuel in relation to the excess air factor. With each fuel type there was a critical point in either thicker or thinner relationships between the air and fuel ratio beyond which it was impossible to fire the mixture. This critical firing value of the excess air factor was greater with the more volatile fuels: 1.08 for ethyl alcohol, 1.0 for gasoline, and 0.75 for heavy oil. In the range of 0.8 or lower, the fuel consumption efficiency was much greater for a less volatile fuel. The effect of the excess air factor on carbon monoxide emissions is decrease emissions with less volatile fuels. Ignition timing has practically no effect on CO emissions, especially with highly volatile fuels. Each fuel was also tested for the amount of CO emission given with the ignition timing set for optimum combustion efficiency.

**33640** **APTIC NO. 56564**

Munakata, Susumu

ENVIRONMENTAL POLLUTION CONTROLS AT THE TOMAKOMAI KYODO POWER PLANT. *(Tomakomai Kyodo karyoku hatsudensho no kogai taisaku ni tsuite). Text in Japanese. Kogai Boshi Netsu Kanri Hokkaido (Hokkaido Assoc. Energy Pollut. Contr.), 26(84):31-34, Jan. 1973.*

The Tomakomai Kyodo power plant was set up to supply the electric power for the production of aluminum at Nippon Light Metal Company s factory and to meet the increase in demand for general electric power in the Muroran and Tomakomai areas. The first generator (250 MW) was installed in May 1971, the second (250 MW) was completed in May 1972, and the third (250 MW) is now under way. The countermeasures against pollution taken by the power plant are the installation of high-powered electric dust collectors and increasing the height of the stacks, together with the installation of a common duct and the reinforcement of the structure of the smokestack. Sulfur dioxide automatic recorders were installed for ordinary time-monitoring, and the automatic air samplers were also set up within a range of 5 to 20 km from the power plant for the determination of the ground level SO2 concentration. At the same time, the diffusion condition of the flue gas from the power plant is being investigated by recording the direction and velocity of the wind over the plant and at 10 odd places within the city.

**33641** **APTIC NO. 56555**

Nakagawa, Isamu and Masaharu Takamatsu

ENVIRONMENTAL POLLUTION CONTROL AT NIPPON STEEL CORP., MURORAN WORKS. *(Muroran Seitetsujo ni okeru kogai taisaku ni tsuite). Text in Japanese. Kogai Boshi Netsukanri Hokkaido (Hokkaido Assoc. Energy Pollut. Contr.), 26(84):5-19, Jan. 1973.*

In the Muroran iron/steel factory, 70-80% of the raw materials are charged in the blast furnace and powered ore is used to sinter; thus, great quantities of soot and smoke are emitted. The dust and soot are removed by multicyclones. Other raw material handling areas have bag filters and electrostatic precipitators. Carbon monoxide and hydrogen from the pig iron blast furnace are recovered to be used as fuel. Coarse dust (3-20 g/N cu m) is first removed by dust collectors and fine dust is removed by secondary dust collectors; 60-70% of the course dust is removed, then the second collector removes dust until only 3-10 mg/N cu m are left. The total dust collection rate is 85-90%. About 70% of the sulfur dioxide emitted is from sintering. By monitoring the sintering operation, SO2 concentration was reduced to less than 0.05 ppm.

**33642** **APTIC NO. 56501**

Nakamura, T.

CORROSION PREVENTION OF EXHAUST GAS DESULFURIZATION PLANTS BY RESIN LINING OR WITH FRP PRODUCTS. *(Jushi rainingu oyobi FRP seihin ni yoru haigasu datsuryu sochi no boshoku ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 40(11):1116-1124, Nov. 1973*

The use of resin linings or fiber reinforced plastics (FRP) in exhaust gas desulfurization plants is discussed. These linings are useful for scrubbers and circulation tanks because of their anti-corrosion properties. Various types of materials and their applications are discussed.

**33643** **APTIC NO. 56814**

Nojima, S.

MRG PROCESS. *(MRG prosesu). Text in Japanese. Sekiyu Gassai-shi (J. Japan Petroleum Inst. Tokyo), 16(10):848-851, Oct. 1973.*

The methane rich gas (MRG) system produces synthetic gas with a caloric value above 9000 kcal/N cu m by methanation and carbon dioxide removal, from the lower caloric gas obtained by the steam reforming of naphtha or liquefied petroleum gas. Kerosenes having a boiling point of 300 C were useable as the raw material. The butane-butene fraction from an ethylene plant, return naphtha extracted aromatics, hydrocarbon condensate separated from natural gas, and crude benzene produced from a coke furnace, may be used as raw materials. Two-stage reactors are employed in the Keiyo Gas plant to increase the efficiency of the hydrocracking. The costs are cited.

**33644** **APTIC NO. 56554**

Oguma, Takashi and Kazuharu Uoyama

OUTLINE OF THE ANTI-POLLUTION FACILITIES AT OJI PAPER CO., LTD., TOMAKOMAI MILL. *(Oji Seishi Tomakomai kojo ni okeru kogai boshi setsubi ni kanshite). Text in Japanese. Kogai Boshi Netsukanri Hokkaido (Hokkaido Assoc. Energy Pollut. Contr.), 26(84):20-24, Jan. 1973.*

Desulfurization of 900 N cu m/hr boiler exhaust was studied in a pilot plant. The stack gas is sprayed with water. Then it enters an absorption tower where the temperature is lowered to 60 C. The gas is moistened and the sulfur dioxide is reacted with caustic soda. The desulfurized gas is discharged through a demister, and the sulfuric acid produced is removed. The caustic soda is recycled and introduced into a sodium sulfite solution. The dust in the stack gas is removed at the spray. The efficiency is more than 80%.

**33645** **APTIC NO. 56690**

Otto, K. and M. Shelef

THE APPLICATION OF 15N IN STUDYING THE HETEROGENEOUS REDUCTION OF NO. *Argonne National Lab., Argonne, Ill., Proc. First Int. Conf. Stable Isotopes Chem. Biol. Med., Argonne, Ill., 1973, p. 448-451. 7 refs. (May 9-11.)*

NTIS: CONF-730525

The reduction of nitric oxide at low concentrations to nitrogen or nitrous oxide is difficult, since the required pair formation between N atoms poses kinetic problems. Thus, the catalytic reduction of NO in automobile exhaust leads to the formation of considerable amounts of ammonia over most catalysts, although NH3 is thermodynamically less stable than N2. Useful information for the NO reduction mechanism was obtained from the reaction between NO and NH3 by labeling one of the reactants by N(15). The absence of certain combinations of N atoms in the reaction products over platinum, copper, and ruthenium suggests a simple reaction scheme, based on two surface complexes. Comparative kinetic measurements of the reduction of NO by hydrogen and NH3 combined with these data describe the relative importance of NH3 as an intermediate product. The results describe the reasons which cause ruthenium catalysts to have a superior selectivity for the formation of N2. The interaction of NO from the gas phase with chemisorbed NO and the solid oxide oxygen at the catalytic surface can be studied by preadsorbing N(14)O(16) and then measuring the exchange with N(15)O(16) and N(14)O(18) from the gas phase. (Author abstract modified)

**33646** **APTIC NO. 56573**

Paganini, Otto

POLLUTION SURVEY OF THE PORTLAND CEMENT PLANTS IN TEXAS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E131-E139.*

Results are presented of a pollution survey made of each of the 18 cement plants in operation in Texas to determine what measures are being taken to prevent emission, mainly dusts. Wet process kilns are served by electrostatic precipitator-type dust arrestors which remove entrained dust from waste kiln gases before discharge to the atmosphere, while dry process units are mainly served by bag filters. All mill kilns are natural gas fired, and most try to maintain 3% or less oxygen in the combustion zone. Exit temperatures are maintained at 360-600 F to prevent recirculation of alkaline salts in the kiln and to prevent their escape through the dust collector in the form of gaseous fume. Dust collected at the kilns is either sluiced as slurry to settling ponds or hauled dry for landfill. Collected dust handling systems employ covered-auger or screw-type conveyors to transfer dust from the collection hopper to enclosed bucket elevators that elevate the dust into covered storage bins. Several plants reuse all or portions of the dust by blending it in with the kiln feed. Air that is not used for combustion air is passed through an inertial type dust collector for removal of entrained particulates. Local exhaust dust collection systems with bag-type fabric dust collectors are employed in most cases to prevent dust emissions at transfer points in the system. Fugitive dust loss from roads is prevented by wetting with water sprays.

**33647** **APTIC NO. 56640**

Pershing, D. W., J. W. Brown, and E. E. Berkau

RELATIONSHIP OF BURNER DESIGN TO THE CONTROL OF NOX EMISSIONS THROUGH COMBUSTION MODIFICATION. *Environmental Protection Agency, Research Triangle Park, N. C., Control Systems Lab., Proc. Coal Combust. Semin., Research Triangle Park, N. C., 1973, p. 87-139. 9 refs. (June 19-20.)*

NTIS: PB 224210/AS

The combustion of propane, distillate oil, a 0.3% nitrogen oil, and pulverized bituminous coal was examined in a versatile laboratory furnace. Testing was conducted to determine the relationship of burner (and process) parameters to the control of nitrogen oxide emissions. The results indicated that propane and distillate oil gave generally about the same NOx emissions, while the 0.3% N oil gave twice as much as coal at least 2.5 times as much. Increased burner throat velocity and flue gas recirculation were extremely effective in reducing thermal NOx, but neither worked satisfactorily with the high nitrogen oil or coal. Increasing air preheat substantially increased the NOx emissions from propane and distillate oil and caused lesser increases with the high nitrogen distillate and pulverized coal. (Author abstract modified)

**33648** **APTIC NO. 56688**

Plaks, Norman

RAPPORTEUR S REPORT FOR TOPIC B. *Preprint, Economic Commission for Europe, 12p., 1973. (Presented at the Seminar on the Control of Emissions from the Non-Ferrous Metallurgical Industries, Dubrovnik, Yugoslavia, Nov. 19-24, 1973.)*

A summary of six papers on the control of emissions from the non-ferrous metallurgical industries is presented ranging in subject content from a discussion of the effects of pollutants upon the environment, to a description of a program which identifies all of the pollutants from a smelter, and finally to discussions of technology for controlling a number of the various smelter emissions. The first paper is concerned with the effect of toxic gases, especially sulfur dioxide, from a smelting operation on surrounding vegetation. Sources of air pollution from installations for pyrometallurgical treatment of copper bearing ores are covered in the second paper, and emphasis is placed on the difficulty of identifying pollutants from such operations. The third paper discusses a SO2 to S reduction process which uses the high temperature route to provide a sufficiently rapid reaction rate, and the fourth paper concerns the control of dusts from Cu smeltering. The use of bag filters for cleaning gas from rotary kilns is reviewed in the fifth presentation, and data are presented which indicate strong potential for improving the operation of bag filters. The last paper is concerned with the control of mercury emissions from smelters, and a process by which roaster gases are made Hg-free with almost total recovery of the Hg is described.

**33649** **APTIC NO. 56514**

Rastogi, K. Vikram, K. S. Shah, and V. Srinivasan

PERFORMANCE OF A MEDIUM SIZED CAR ENGINE WITH AN ANTI-SMOKE ADDITIVE IN THE FUEL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. F26-F29. 1 ref.*

Results of laboratory investigations using an anti-smoke fuel additive on a medium-sized car engine (8 years old) are presented. Smoke density was found to first decrease and then increase with increasing concentrations of additive, although all values remained much lower than for pure gasoline. An additive concentration of 0.02% reduced smoke density by 75% at full load, while a reduction of 43.75% was obtained at no load. Rated engine power was developed for concentrations between 0.01 and 0.02%. Volumetric efficiency and exhaust temperature increased with percentage increase of additive from no load to full load. Brake-specific fuel consumption was lower with additives, and lowest values were obtained at full load 0.02% concentration. Increase in the percentage of additive resulted first in a decrease in heat given to the cooling water and then an increase as additive was continually increased.

**33650** **APTIC NO. 56401**

Risser, Hubert E.

THE U. S. ENERGY DILEMMA: THE GAP BETWEEN TODAY S REQUIREMENTS AND TOMORROW S POTENTIAL. *Illinois State Geological Survey, Urbana, Ill., Environmental Geology Notes No. 64, 65p., July 1973. 87 refs.*

The environmental problems in the production of coal and nuclear energy are discussed in a report on the use and availability of energy in the United States. The continued use of coal is hampered by the environmental effects of the emission of particulate matter and sulfur dioxide during combustion. Particulates can be controlled by electrostatic precipitators. Methods of controlling SO2 are being investigated and include:

use of low-sulfur coal, flue gas desulfurization, coal cleaning, coal refining, and coal conversion. The permanent disposal of radioactive wastes from nuclear power production has no satisfactory solution.

**33651** **APTIC NO. 56786**

Roessler, W. U., E. K. Weinberg, J. A. Drake, H. M. White, and T. Iura

INVESTIGATION OF SURFACE COMBUSTION CONCEPTS FOR NOX CONTROL IN UTILITY BOILERS AND STATIONARY GAS TURBINES. (FINAL REPORT). *Aerospace Corp., El Segundo, Calif., Urban Programs Div., Environmental Protection Agency, Office of Research and Development Grant R-801490, Program Element 1A2014, Aerospace Rept. ATR-73(7286)-2, Rept. EPA-650/2-73-014, 185p., Aug. 1973. 75 refs.*

NTIS: PB 224424/AS

The state-of-the-art of concepts of surface combustion and their applicability to large utility boilers and stationary gas turbines are discussed. Both noncatalytic and catalytic devices are reviewed. Typical catalysts, catalytic processes, substrates, catalytic degradation, automotive oxidation catalysts, tail gas abatement catalysts, low-temperature catalytic combustors, and high-temperature catalytic combustors are reviewed. Porous-plate and catalytic surface combustors for large utility boilers are evaluated including nitrogen oxide emission targets, boiler design requirements, and burner characteristics. Catalytic and noncatalytic surface combustion concepts for stationary gas turbines are evaluated including operating characteristics, emissions, NOx emission goals for large power installations, and fuel preparation and preignition problems. Catalytic combustion looks promising for gas turbines; however, comprehensive experimental and theoretical investigations are required for a meaningful assessment. Catalytic combustion is not yet feasible for existing steam boilers, but might apply to new units. Sintered metal porous-plate combustors with imbedded cooling tubes (noncatalytic), although technically feasible for steam boilers and possibly for low-pressure ratio gas turbines, have packaging problems and require gaseous and distillate fuels.

**33652** **APTIC NO. 56742**

Rosenberg, Harvey S., Joseph M. Genco, Richard B. Engdahl, David M. Jenkins, and Joseph H. Oxley

STATE-OF-THE-ART REPORT ON STATUS OF DEVELOPMENT OF PROCESS FOR ABATEMENT OF SO2 EMISSIONS BY STACK GAS TREATMENT TO AMERICAN ELECTRIC POWER SERVICE CORPORATION. MARCH 30, 1973. *Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., 65p., 1973. 9 refs.*

An attempt has been made to assess the current status of the various process for abatement of sulfur dioxide emissions by stack gas treatment at coal-fired power plants, to estimate the time required to bring them to successful commercial operation, and to forecast the reliability of such processes in the future. Some reasonably well-developed processes that have gained some degree of utility company acceptance on an experimental basis in the United States include: Limestone injection, wet or dry collection; wet lime/limestone scrubbing; alkali scrubbing without regeneration, with calcium regeneration, with thermal regeneration, or with electrolytic regeneration; magnesium oxide scrubbing; and catalytic oxidation. The Delphi forecasting technique was used to forecast the future reliability of flue gas SO2 removal systems because of the difficulty in projecting current state of the art into the future. A demonstrated level of efficient SO2 recovery with 90% reliability over a year of operation on any full-size, coal-fired unit will probably not occur before 1975; and it is highly unlikely that most utilities can meet the 1975 deadlines for compliance with Federal and State SO2 emission regulations without shifting to gas, oil, or western coal.

**33653** **APTIC NO. 56627**

Rothwell, E. and P. Swift

FILTRATION OF REACTIVE DUSTS IN FABRIC FILTERS--THE PRACTICAL ASPECTS. *Process Eng., p. 104-105, 107-109, Oct. 1973. 5 refs.*

The problems encountered in filtering thermically labile dusts and those dusts which are exposed to extreme conditions of temperature and/or humidity are discussed. Poor overall plant operation can occur when fabric filters are used to separate the solid phase from fluidized-bed, pneumatic, or spray dryers. Two types of problems may occur within a filter unit operating in such a plant: thermal degradation, which can involve thermal decomposition with evolution of heat or oxidation with evolution of heat; and abnormal thermal effects. Possible locations within the production process where a particle may be subjected to the latter are the dryer, the transfer line and/or filter, and the storage hopper. Undesirable thermal effects can also result when a minor fraction of the product is subjected to an extended residence time within a recirculation zone. Although the likelihood of a thermally modified particle coming into contact with a fiber of the filter medium is relatively remote, under conditions of extended operating such contact can occur. In the case of particular organic solids, further reaction in the high humidity atmosphere in the filter unit may lead to the formation of a viscous liquid phase. If the filter fibers become wetted by this phase, adhesion of normal product on the fibers can lead to failure of the system. This effect may be exaggerated where the product may be recycled to the filter after further operation. Thus it is important to know as much as possible about the behavior of individual solids when they are subjected to an extended residence time in process plants.

**33654** **APTIC NO. 56905**

Rukavishnikov, A. I.

TASKS OF CHEMISTS IN CLEAN AIR MAINTENANCE. *(Zadachi khimikov v zashchite okruzhayushchey atmosfery). Text in Russian. Khim. Tekhnol., no. 4:3-4, 1973.*

Tasks and achievements in the clean air maintenance area in the chemical industry of the USSR are outlined. Carbon disulfide and hydrogen sulfide in synthetic fiber manufacturing, nitrogen oxides in nitric acid production, and sulfur dioxide in sulfuric acid production are among the major emissions in the chemical industry. Gas cleaning and dust separating equipment are necessary to abate harmful emission from chemical plants, while new plants should be designed with respect to a minimization of such emissions. Technological improvements contribute also considerably to air pollution abatement. Nitrogen oxides, generated by nitric acid production processes, can be eliminated through thermal incineration, or by catalytic destruction by means of palladium treated alumina catalyst.

**33655** **APTIC NO. 56490**

Schaum, Jack

CHRYSLER INITIATES ODOR CONTROL AT HUBER AVENUE FOUNDRY. *Mod. Casting, 1973:35-38, Aug. 1973.*

A charcoal adsorbent odor control system installed at Chrysler Corporation s Huber Avenue Foundry is described. The system consists of 12 parallel adsorber compartments, each containing five vertical filter panels completely filled with 4 by 8 mesh activated charcoal (density of 0.44-0.48) with an actual thickness of about four inches. Panels are arranged in a series of V configurations so that gases coming from one side must proceed through the charcoal before exiting through a V on the other side of the chamber. Approximately 2400 lbs of activated charcoal are on stream in each compartment which handles 10,500 cfm of odorous gas. A carbon-filled reservoir and hopper act as gas seals as the air stream passes horizontally through the panels. This stream deposits dust and odor contaminants on the charcoal, then exits through an exhaust plenum. The temperature of the incoming gas is held between 80-150 F. Air exhausted from three shakeouts in the plant first passes through a wet, multicyclone dust collector and is then diverted through the odor control unit for final exhaustion. A small amount of very fine dust still in the scrubbed air salts out on the charcoal bed surface, the effect being a reduction in dust emission also. A total of 22 different organic compounds captured from the effluent by the charcoal have thus far been identified.

**33656** **APTIC NO. 56591**

Schmidt, Ernst

IS A SOLUTION OF THE FLUORINE EMISSION PROBLEM IN THE BRICK INDUSTRY IN SIGHT? (Ist eine Loesung des Fluor-Immissionsproblems in der Ziegelindustrie in Sicht)? Text in German. Luftverunreinigung, 1973:38-46, 1973. 6 refs.

The dry injection of calcium hydrate (calcium hydroxide) in brick kilns was tested. The method aims at the reduction of the oxides of sulfur and particularly of the aggressive fluorine compounds. First the injection of the pulverized substance directly into the kiln was tested to see whether a reduction of the SOx present in high concentrations in the flue gas indirectly also reduces the fluorine emission. Earlier studies had shown that the driving off of fluorine compounds from brick parts was greatly influenced by the concentration of sulfur dioxide. The fluorine emission could be considerably reduced. The direct contact of the brick material with the pulverized calcium hydrate permitted the application of this method only for products which require no pure color. Very favorable results were achieved with the injection of only 1/3 of the calcium hydrate into the furnace and 2/3 (of a total of 5 kg/hr) into the smoke collector leading to the stack. The fluorine emission could be reduced from the long-term average if 70 mg/cu m waste gas to less than 3.5 mg/cu m, which is a reduction of more than 95%. Similar favorable results were achieved with the sole injection of the calcium hydrate into smoke flue outside the furnace provided the reaction path was sufficiently long. Through this the dust emission may be increased to beyond the existing limit concentrations. The problem of a suitable dust collector in this case remains to be solved.

**33657** **APTIC NO. 56921**

Setsuraku, Masao

THE MEASURES OF SOLVING THE ENERGY PROBLEMS FROM THE VIEWPOINT OF PUBLIC NUISANCE. *(Kogai men kara mita enerugi taisaku). Text in Japanese. Netsu Kanri to Kogai (Heat Management Public Nuisance), 25(10):42-49, Oct. 1973.*

Notification No. 35, issued on May 16, 1973 by the Japanese Department of Environment, states that the annual average standard for one-hour values of sulfur dioxide is lowered to 0.012-0.015, and that nitrogen dioxide and photochemical oxidants are currently considered to be pollutants. Standards for one-hour values of SO2 and NO2 are 0.1 and 0.06 respectively, and one-day averages of one-hour values are 0.04 and 0.02 ppm. Current one-day averages of NO2 measured at 34 stations are 0.04 in relatively non-polluted areas, and highly contaminated regions each 0.06 ppm. These values must be made to conform with the environmental standards within 5 years and 8 years, respectively. The new exhaust standards for NOx are applicable to boilers, furnaces, and nitric acid plants. The concentration of NOx is calculated by the percent of oxygen in the stack gas. Current control measures include the use of low-sulfur fuel, desulfurization by hydrogenation, the use of crude oil, naphtha, liquefied natural gas, methanol, and synthetic natural gas as fuel, and the modification of firing methods.

**33658** **APTIC NO. 56879**

Sidorenko, V. F., G. P. Kirillov, and Yu. G. Fel dman

A STUDY OF GAS PROTECTING PROPERTIES OF GREENERIES ALONG THE HIGHWAYS. *(Issledovaniye gazozashchitnoy effektivnosti zelenykh nasazhdeniy na avtomagistralyakh). Text in Russian. Gigiena i Sanit, no. 10:6-8, 1973. 5 refs.*

The effect of rows of trees and shrubs along highways and streets on the abatement of automobile exhaust-generated pollution was studied by the measurement of the carbon monoxide and nitrogen dioxide concentrations on both sides of such protective rows. Rows of trees, and especially of shrubs, were found to be considerably abate automobile exhaust-generated emissions as a function of the species used, the plantation density, and the density of the foliage. The density coefficient of rows of trees and shrubs, a factor characterizing the protective efficiency of such rows against exhaust emissions, was determined by photometric analysis of negatives taken from such rows with the background removed by a special photographic procedure.

**33659** **APTIC NO. 56830**

Slater, W. L., A. M. Robin, and W. G. Schlinger

PARTIAL COMBUSTION OF HIGH-SULFUR RESIDUAL FUELS FOR DIRECT PRODUCTION OF METHANE-RICH FUEL GAS. *(Ko iou zanyu no bubun sanka niyoru metan ricchi nenryo gasu no chokusetsu seizo). Text in Japanese. Sekiyu Gakkai-shi (J. Japan Petroleum Inst., Tokyo), 16(10):852-854, Oct. 1973. 4 refs.*

A synthetic gas generation process is described which produces methane rich fuel gas with 400-600 Btu/cu ft caloric value and no sulfur content by combustion of high sulfur residual oil instead of expensive and less efficient methanation of carbon monoxide and hydrogen. Pilot plant work was done to prove that the methane content of the dry gas with no carbon dioxide content could be enriched. The residual oil was gasified, the synthesis gas was passed through a waste heat boiler into a quenching system where soot was separated, and CO2 and hydrogen sulfide were removed from the cool gas. The reformation efficiency of the fuel gas decreased in proportion to the increased caloric level. The soot can be recycled to the feedstock. Reformation efficiency and fuel stock amount can be improved by increasing reaction tower pressure.

**33660** **APTIC NO. 56730**

Sorensen, Harold P.

LIMITED OIL GASIFICATION EXPERIMENT. (FINAL REPORT). *International Materials Corp., Burlington, Mass., Environmental Protection Agency Contract 68-02-0296, EPA-R2-73-272, Program 1A2013, 43p., June 1973.*

NTIS: PB 223653/AS

Tests were run to evaluate the capability of the SEGAS oil gasification process on No. 2 and No. 4 fuel oil and on No. 6 high sulfur residual oil. Existing hardware, which was designed to fit within the envelope constraints of an automotive application and to operate on unleaded automotive gasoline, was used as the test reformer. The reformers consists of three finned tubes connected in series and mounted in the hot gas outlet of a burner. A boiler-superheater combination, mounted over the reformer and located in the same hot gas stream, supplied the steam to the reformer for the petrochemical process within the reformer. The calibration and endurance programs were completed with qualified success on No. 2 fuel and were completed successfully on No. 4 fuel oil. In the former case, the endurance test produced a carbon buildup that is thought to have been caused by operating off the test point because of inadequate control of the process. The lack of carbon buildup in the reformer on the No. 4 fuel oil endurance test indicates that the process was being conducted in a state of equilibrium. The calibration program on the No. 6 oil was not completed, although progress was made toward achieving stable operation of the system. Samples of the product gas were taken at specific times throughout the endurance test programs. Some of these samples were analyzed by gas chromatography at International Materials, while the others were sent to an outside laboratory for independent analysis. (Author summary modified)

**33661** **APTIC NO. 56528**

Sparwald, Volker

STUDY OF THE VOLATILIZATION OF ACCOMPANYING ELEMENTS AT ALUMINUM FUSION ELECTROLYSIS. *(Beitrag zur Verfluechtigung der Begleitelemente bei der Aluminium-Schmelzflusselektrolyse). Text in German. Erzmetall, 26(11):529-533, Nov. 1973. 12 refs.*

Total encapsulation of the furnaces for experimental fusion analysis by a pilot plant for adsorption of fluorine compounds on aluminum oxide permitted the study of the volatilization of important elements such as silicon, iron, titanium, phosphorus, vanadium, zinc, and gallium. The adsorption process for fluorine has been extensively described earlier. It is based on the formation of a fluidized bed between aluminum oxide and waste gas. The process reduces the gaseous fluorine to a residual concentration of 1 mg/cu m. The major disadvantage of the method is that together with the retained fluorine volatile fractions of the above elements are returned to the furnace where they reduce the quality of the metal by 0.05 to 0.06%. The dry waste gas cleaning method developed by Lurgi requires only 10% of the oxide consumed by the furnaces for the fluorine adsorption. This has the advantage that the volatile pollutants are concentrated in a relatively small oxide quantity which limits the reduction of the metal quality to only part of the production.

**33662** **APTIC NO. 56938**

Squires, B. J.

NEW DEVELOPMENTS IN THE USE OF FABRIC FILTER DUST COLLECTORS IN THE STEEL, NONFERROUS, AND FOUNDRY INDUSTRIES. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E27-E30. 1 ref.*

In the steel industry, fabric filter dust collectors are used to: eliminate visible emissions to the atmosphere; clean the gases from electric arc mmelting furnaces; and remove incandescent carbon particles and iron oxide fume which are emitted when molten metal is transferred from torpedo ladles into another ladle during refining. Filters are also being used in sinter plants, oxygen convertors, and oxygen scarfing billets. In the non-ferrous industry, fabric filters are used to handle the fine dust given off by ferroalloy furnaces, to clean the large volumes of exhaust gases generated in primary aluminum plants, and to clean the gases given off by lead plants. The copper, zinc, and secondary aluminum industries also use high temperature fabric filters. By careful planning and, in some cases, mixing the exhaust volumes from the different sources, one centralized fabric filter plant can handle practically all the dust generated by a foundry. Another new development is the use of the continuous-cleaning reverse jet fabric filter by foundries. Fabric filters have many more industrial applications due to their high cleaning efficiency, simplicity of operation, and reasonable cost.

**33663** **APTIC NO. 56837**

Stanley, S.

FABRIC DUST COLLECTORS. *Clean Air (J. Clean Air Soc. Australia New Zealand), 7(3):53-58, Aug. 1973.*

The various aspects of fabric dust collector design are discussed. The actual mechanisms of filtration in fabric dust collectors are interrelated in a complex fashion; they include sieving, inertial impaction, diffusion, and electrostatic effects. Once the separation process has started, a considerable dust layer will accumulate on the filter surface and between the fibers; this layer will act as a filtration cake. In that the cake will act as an effective secondary collector, reconditioning of the filter layer in terms of dust cake removal is a delicate process related to the resistance of the collector to airflow. The following factors must be considered in a modern collector unit design: type of porous layer, which may consist of natural or synthetic textile materials; the reconditioning mechanism and/or action and control equipment; the inlet and outlet manifold and/or connections and dampers; the casing or housing and dust storage hopper or hoppers; the dust disposal equipment; and the supporting structure, ladders, and platforms.

**33664** **APTIC NO. 56781**

Stastny, E. P.

ELECTROSTATIC PRECIPITATORS--A MANUFACTURERS VIEW. *Air Pollution Control Assoc., Pittsburgh, Pa., Proc. Spec. Conf. Des. Oper. Maint. High Effic. Contr. Equip., St. Louis, Mo., 1973, p. 93-97. (March 29-30.)*

The selection, application, and maintenance of electrostatic precipitators are discussed from a manufacturer's viewpoint. The most successful application of electrostatic precipitators to industrial processes is the product of many factors, particularly experience. Bid specifications and bid evaluation are essential to satisfactory installation. The person drawing the spec should consult with the operators, maintenance people, and suppliers, and should visit similar installations. He should be looking for the operating gas volume, gas temperature, particulate loading, moisture, process feed variables, ductwork design, and operator characteristics. In evaluating a bid, only the precipitator should be considered; auxiliaries can be negotiated or bought elsewhere. Specs should protect against equipment breakdown, future tightening of emission regulations, temperature excursion, and routine internal maintenance. After equipment is installed and operating, problems that occur may be due to incorrect maintenance. One person should have total responsibility for understanding the precipitator and keeping it in good working order.

**33665** **APTIC NO. 56553**

Suwa, Tasuku

TECHNIQUES FOR REMOVING NITROGEN OXIDES EMITTED FROM STATIONARY FACILITIES AND ITS PROBLEMS. *(Kotei shisetsu kara hasseisuru chisso sankabutsu no jokyo gijutsu no genjo to sono mondaiten). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(1):17-22, Jan. 1973. 48 refs.*

Combustion facilities contain 300-1500 ppm of nitrogen oxides. Improved combustion can reduce NOx by 40-70%. Catalytic reduction, used mainly to remove NOx from nitric acid manufacturing exhausts, has a high efficiency but is expensive. Adsorption by activated carbon is effective but complex. Absorption at one stage only is the best absorption method.

**33666** **APTIC NO. 56509**

Takahashi, Shunichi

POLLUTION CONTROL IN NITTETSU CEMENT FACTORY. *(Nittetsu semento kojo ni okeru kogai boshi taisaku ni tsuite). Text in Japanese. Kogai Boshi Netsukanri Hokkaido (Hokkaido Assoc. Energy Pollut. Contr.), 26(85):8-10, March 1973.*

In a rotary kiln, the lime in raw materials is decomposed by heat to form calcium oxide; the calcium oxide is reacted with sulfur dioxide and oxygen produced by combustion of heavy oil at 500-1300 C to form calcium sulfate, most of which is adsorbed in the cement clinker. Thus, 80-95% of the SO2 produced is removed in the cement manufacturing process. Most of the dust (10-80 g/N cu m) is exhausted from the cement kiln and dryers. The dust is recovered by electric dust collectors for reuse. Lowering temperature or humidity can increase dust collection to 99.5%. Cyclones and bag filters can also be installed. This system is used in the Nittetsu cement factory.

**33667** **APTIC NO. 56929**

Takasaki, Shoichi

NOX REMOVAL BY THE WET OXIDATION ABSORPTION METHOD. *(Shisshiki sanka kyushuho ni yoru NOx jokyo). Text in Japanese. Kemikaru Enjiniyaringu (Chem. Eng.), 18(10):1116-1122, Oct. 1973. 1 ref.*

A wet oxidation absorption method removes 95% of the nitrogen oxides from its stack gases and an even higher ratio of smoke removal. Waste gases go through a venturi scrubber, NaClO2 column, activated charcoal, NaOH, cotterel, and a stack, and the waste fluid goes to a treatment tank. When the new oxidizer, Fuji-non-ox, is added, 200 ppm nitric oxide becomes 100 ppm nitrogen dioxide and the remaining NOx is fixed as nitric acid. A new absorption equipment uses several tiers of leaking shelves with a new absorption liquid, Fujinon-N liquid. The new oxidizer cuts oxidation time to less than a sec for 100% oxidation and requires no oxidation reactor. By-product recovery within this closed system is possible.

**33668** **APTIC NO. 56869**

Tamaki, A. and H. Yanagioka

A NEW LIMESTONE PROCESS FOR SO2 REMOVAL FROM FLUE GASES. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. E45-E48. 3 refs.*

The most advanced systems for the desulfurization of flue gases are the lime-slurry scrubbing systems. The Chivoda Thoroughbred 101 flue gas desulfurization process, which uses very dilute sulfuric acid as an absorbent, eliminates the problems of scaling on the scrubber surfaces and plugging of the pipe lines. The sulfur dioxide absorbed during the process is oxidized by air to yield sulfuric acid, which is neutralized by limestone to produce saleable gypsum. This system can also be used to desulfur coal-fired boiler flue gases, smelter gases, and tail gases from Claus sulfur plants. A flow diagram of the process is provided, and the effect of the following operating variables on SO2 removal is discussed: liquid-to-gas ratios, sulfuric acid concentrations, initial SO2 concentration, the oxygen concentration in the flue gas, and the catalyst. The system is designed to produce gypsum of sufficient quality to be usable as a retarder for Portland cement and in the manufacture or plaster or wallboard. The operating data from two commercial installations used to desulfur flue gases from residual-oil burners are summarized.

**33669** **APTIC NO. 56545**

Tsuji, Shoichi

CONTROL OF NOX EMISSIONS FROM BOILERS BY IMPROVEMENT OF THE COMBUSTION METHOD. *(Nenshoho no kaizen ni yoru boira ni okeru sanka chisso hassei no yokusei). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(10):1102-1104, Oct. 1973.*

Nitrogen oxides can be controlled by improvements in combustion methods and equipment. The air preheating temperature can be lowered and the amount of combustion can be reduced; however, these methods lower efficiency of combustion. Lower excess air combustion is a more effective control method. Design of combustion equipment must consider the lowering oc combustion temperature, particularly the reduction of the maximum temperature. The combustion chamber can be increased in size to reduce temperature. The flame area load or the volume load in the area where the heat emission is greater can be reduced. Two-stage combustion and fuel additives can also be used to reduce NOx.

**33670** **APTIC NO. 56904**

Voisin, J.

POROUS-LAYER OR FIBROUS-LAYER FILTERS. *(Filtres a couches poreuses ou fibreuses). Text in French. Tech. Moderne, no. 9:37-40, Sept. 1973.*

Porous-layer and fibrous-layer filters, suitable for the removal of high dust contents from industrial emissions and trace amounts of dust for especially high requirements, are described. Dust separation by such filters is due to the screen effect, sedimentation, impact, interception, diffusion, and electrostatic charge. The efficiency of layer filters is a function of such parameters as particle size, fiber fineness, air flow rate, thickness of the filter layer, and the degree of soiling of the filter medium. Dedusting is possible by mechanic knocking, clean air led through the filter in countercurrent, air jet, and their combinations. Natural fibers, such as of cotton and flax, have limited use due to their poor thermal stability. Polypropylene, polyesters, polyacrylonitriles, aromatic polyamides, and teflon are widely used, and so are mineral fibers, such as glass-fiber which is able to withhold temperatures of up to 275 C in continuous operation. Bag filters have separation efficiencies exceeding 99%.

**33671** **APTIC NO. 56815**

Watanabe, Katsuro and Akimasa Kataoka

A METHOD OF MANUFACTURING A SULFITE USING UNREACTED GAS FROM SULFUR-RECOVERING EQUIPMENT IN OIL REFINERY. *(Sekiyu seisei kojo ni okeru io kaishu sochi kara haishutsu sareru mihanno gasu o katsuyosuru aryusanen no seizoho). Text in Japanese. (Nagao Soda Co., Ltd., Okayama (Japan)) Japan. Pat. Sho 48-35158. 5p., Oct. 26, 1973. (Appl. Dec. 27, 1969, 1 claim).*

Waste gases from an oil refinery desulfurizer containing sulfur dioxide, hydrogen, sulfur, carbon dioxide, and carbonyl sulfur can be reburned to convert the hydrogen sulfide and COS to SO2 and CO2. The gas is then washed with sulfite solution, sulfuric acid in water, or an acid solution of a sulfate. The washing solution is reacted with caustic alkali water to form acid sulfite. The acid sulfite is neutralized to form a sulfite which is recovered.

**33672** **APTIC NO. 56414**

White, David J., P. B. Roberts, and W. A. Compton

LOW NOX EMISSION COMBUSTOR FOR AUTOMOBILE GAS TURBINE ENGINES. *International Harvester Company, San Diego, Calif., Solar Div., Office of Air and Water Programs Contract 68-04-0016, APTD-1441, 104p., Feb. 1973.*

NTIS: PB 222818

Several model combustors were produced employing various concepts to obtain low emissions, and these were evaluated as to their suitability for incorporation into a practical engine system. The criteria for evaluation were, in order of importance: low emissions of oxides of nitrogen, carbon monoxide, and unburned hydrocarbons; acceptable pressure loss; stability equivalence ratio range sufficient for entire engine operating range; simplicity of variable area control; absence of smoke and odor; and reasonable weight and size. Of the various models tested, when operated with liquid fuels, the most promising concept was that designated the Jet Induced Circulation (JIC) combustor system. Two combustors utilizing the basic JIC concept were designed and built: one for a low pressure regenerative engine cycle; and one for a high pressure cycle system with partial recuperation. With these two combustors, the 1975-76 Federal emission requirements could easily be met and bettered, provided some satisfactory variable area system and control could be devised. The available operating range of the JIC combustor could be considerably extended with configurational modifications in the area of combustor diameter, length, and number of primary ports. The control of a variable-geometry JIC type combustor, necessary to maintain emissions below requirements, is likely to be a difficult problem, although not outside current capabilities. Improvement in the low emission operating range could alleviate the problem considerably. Various variable geometry port designs are available for consideration in a JIC type combustor system, and both mechanical and fluidic devices appear attractive at this time. (Author summary modified)

**33673** **APTIC NO. 56946**

Wolfermann, H. F.

ODOR CONTROL IN THE WEST GERMAN AGRICULTURE. *(Geruchsbeseitigung in der Landwirtschaft der Bundesrepublik). Text in German. Ingenieursblad, 42(20):544-551, 1973.*

Methods applied to odor control in livestock farming in West Germany are described. Observation of essential hygienic requirements and the use of airtight collectors and pipelines for manure are the basic ways of abating malodorous emissions. Vent air scrubbing, such as the Rimu process, is currently regarded as the most advanced and most efficient method of odor control, especially in winter. Ozonization by means of UV lights, as well as a combination of scrubbing, filtration, and absorption on Collosanilan are among the latest developments in vent air odor control. If the above techniques are not practicable or unnecessary, rapid dilution of the malodorous vent air can be achieved through releasing it vertically at least 1.5 m above the highest point of the given building. Malodorous emissions from liquid manure can be partially abated by aeration.

**33674** **APTIC NO. 56626**

Yamane, Kiyotaka, Toshiaki Yano, Kenichi Ito, and Shoichi Fukazawa

EXHAUST GAS FROM A GASOLINE AUTOMOBILE AT LOW TEMPERATURE - ESPECIALLY CARBON MONOXIDE DURING WARMING UP. *(Teionji ni okeru gasorin jidosha no haigasu - tokuni dankichu no CO ni tsuite). Text in Japanese. Preprint, Hokkaido Branch of the Japan Society of Mechanical Engineers, Sapporo, p. 115-118, 1973. (Presented at the Japan Society of Mechanical Engineers, Hokkaido Branch, Lecture Meeting, 16th, Muroran, Japan, Oct. 7, 1973.)*

A gasoline engine automobile and its exhaust gas reduction device are tested for performance in temperatures ranging from 15 C to below zero. Carbon monoxide emissions for warm-up during idling, and during driving were measured. During idling warm-up, the choke valve opening was adjusted according to the progression of warming up in order to measure CO concentration, oxygen concentration, engine rpm, exhaust gas temperature, and temperature of cooling water in the water jacket and the radiator. In the driving warm-up test, the standard 10-mode drive test was repeated while measuring the contents of the exhaust gas. With a water-cooled, four-cycle engine in the idling warm-up, the CO concentration decreased to 1/2 from one-third in 5-10 min, indicating the progress of warming up and a thinner air-fuel mixture resulting from the greater opening of the choke valve. The O2 gradually decreased with time while the engine revolution increased with time, but decreased with the wider opening of the choke. In the driving warm-up test when the opening of the choke was increased with time, the average CO concentration was 6-6.5% in the first and second cycles of the 10-mode drive operation, and 3.5-4% thereafter. After 20 min, it was about 3%. The CO concentration of the exhaust gas was 8% or higher with the choke opening up to 1/4-1/2 in winter for both cases.

**33675** **APTIC NO. 56441**

Yang, R., Jih Chang, and Reiner Decher

PART-LOAD CHARACTERISTICS OF A LOW POLLUTION TWO-STAGE BURNING AUTOMOTIVE ENGINE. *Preprint, American Society of Mechanical Engineers, New York, 8p., 1973. 3 refs. (Presented at the American Society of Mechanical Engineers, Intersociety Conference on Transportation, Denver, Colo., Sept. 23-27, 1973.)*

The part-load efficiency, speed characteristics, and engine cycle parameters of an automotive engine optimized for low emissions and low fuel consumption are presented. A practical automotive engine employing fuel-rich followed by fuel-lean burning appears possible of being built using a positive displacement compressor and a turbine expander around the conventional Otto cycle as the first-stage combustor. The power output of the engine is satisfactorily varied by controlling only the mass flow rate through the expander. Part-load fuel consumption appears to be very competitive with the unmodified Otto cycle engine with the additional advantage that the two-stage engine can burn low octane fuels. A modest Otto cycle compression ratio and a compressor pressure ratio near 4, together with operation at an Otto cycle fuel-air equivalence ratio in the area of interest for oxides of nitrogen suppression, yield the most economical cycle configuration. (Author abstract modified)

**33676** **APTIC NO. 56881**

Yatsunami, K.

RECYCLING TECHNOLOGY OF DUST GENERATED AT STEEL MILLS. *(Seitetsusho de no hassei dasuto no sairiyo gijutsu). Text in Japanese. Kinzoku (Metals) (Tokyo), 43(10):18-22, Oct. 1973.*

By-product recovery of dusts in waste gases from the steel industry can be accomplished by sintering, making oxidized pellets, and direct reduction. In direct reduction, the dust recovered is converted directly back into iron for recycling in the steel-making process. The formation of a ring-shaped wall inside the rotary kiln during this process reduces recovery. This problem occurs also in the pelletizing of dusts from stack gases and can be avoided by improving pelletizing technology and rigidly controlling temperatures during the drying and preheating stages. The use of converter dust hardens the pellets and improves reduction speed and productivity.

**33677** **APTIC NO. 56496**

Ministry of International Trade and Industry (Japan), Council of Industrial Science and Technology

AN INTERIM REPORT OF ENVIRONMENTAL CONSERVATION COMMITTEE. *(Kogyo gijutsu kyogikae kankyo hozen gijutsu bu kai chukan hokoku). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 9(9):946-957, Sept. 1973.*

The Environmental Conservation Committee was established in Aug. 1972 as part of the Ministry of International Trade and Industry to investigate pollution prevention procedures. Nitrogen oxide emission control techniques and closed system operation are discussed. The state of the arts is discussed. Future studies of NOx control and analytical techniques are proposed.

**33678** **APTIC NO. 56508**

Hokkaido Electric Power Co., Inc. (Japan), Thermal Power Dept.

COUNTERMEASURE FOR PREVENTION OF ENVIRONMENTAL CONTAMINATION AT A THERMAL POWER PLANT. *(Karyoku hatsudensho ni okeru kogai boshi taisaku). Text in Japanese. Kogai Boshi Netsukanri Hokkaido (Hokkaido Assoc. Energy Pollut. Contr.), 26(85):2-4, March 1973.*

Wet desulfurization and fuel improvement can be used to control thermal power plant pollution. The wet method, the sodium sulfite-gypsum method, the lime-gypsum method, the activated manganese oxide method have been used at many plants. By-product sulfur can be used to produce gypsum, sodium sulfate, and other useful substances.

**33679** **APTIC NO. 56531**

Nissan Engineering Co., Ltd. (Japan)

WET TYPE NITROGEN OXIDES REMOVAL METHOD. *(Chissosankabutsu no shisshiki jokyoho). Text in Japanese. Preprint, Japan Petroleum Inst., Tokyo, 14p., 1973. 1 ref. (Presented at the Japan Petroleum Institute, Meeting on NOx Reduction, Tokyo, Japan, Aug. 29-30, 1973.)*

The NE wet denitration process uses a solution of permanganate as an oxidation/absorption agent for removal of nitrogen oxides in waste gas. It removes both nitrogen dioxide and nitric oxide, as well as hydrogen chloride and hydrogen fluoride. A waste gas of 2000 cu m/hr with an NOx concentration of 4000 ppm or less gives only 100 ppm or less NOx after denitration. It is not difficult to reduce the NOx content further to only 20 ppm. No secondary pollution occurs.

**33680** **APTIC NO. 56544**

Hakodate Dock Co., Ltd. and Hakodate Shipyard Safety and Sanitation Section (Japan)

GENERAL DESCRIPTION FOR POLLUTION CONTROL AT HAKODATE DOCK CO., LTD., HAKODATE SHIPYARD. *(Hakodate Zosenjo ni okeru kogai taisaku no gaikyo). Text in Japanese. Kogai Boshi Netsu kanri Hokkaido (Hokkaido Assoc. Energy Pollut. Contr.), 26(85):25-26, March 1973.*

Pollution control at the Hakodate shipyard consisted of dust measurements, stack gas measurements, training of engineers in measurement techniques, and use of a waste oil facility. Waste wood, sludge, and oil are burned for disposal.

**33681** **APTIC NO. 56691**

Asbestosis Research Council, London (England)

RECOMMENDED CODE OF PRACTICE FOR THE HANDLING AND DISPOSAL OF ASBESTOS WASTE MATERIALS. *14p., March 1973.*

Recommended ways of handling and disposing of asbestos in order to meet the British Asbestos Regulations of 1969 are discussed. Methods of collecting fine dust, loose fiber, swarf, floor sweepings, waste materials from fixing or stripping of insulating materials, offcuts, broken pieces, empty bags, and blue asbestos are mentioned. These include bag filters, exhaust systems, vaccum cleaners, and waste receptacles. Asbestos waste should be disposed of so that there is no dust emission during transport or tipping. The precedures for waste disposal contractors and contact with local authorities are described. An appendix describes notification of removal or deposit of asbestos waste in accordance with the Deposit of Poisonous Waste Act of 1972.

## 1972

**33682** **APTIC NO. 56665**

Austin, Thomas C.

AN EVALUATION OF THREE HONDA COMPOUND VORTEX CONTROLLED COMBUSTION (CVCC) POWERED VEHICLES. *Preprint, Environmental Protection Agency, Test and Evaluation Branch, 11p., Dec. 1972.*

Confirmatory tests have been conducted by the Environmental Protection Agency on three Honda automobiles featuring compound vortex controlled combustion (CVCC) engines which reportedly meet the Federal emission requirements for model year 1975 without after-treatment devices. The CVCC engine burns a heterogeneous air-fuel mixture and obtains stratification with the use of a prechamber. Two separate intake valves are used for each cylinder, one being located in the prechamber and the other in the main chamber. Results of the confirmatory testing showed that all three vehicles repeatedly met the emission levels required for 1975 with no significant fuel economy or driveability penalty associated with the engine. There is an adequate cushion in the emission levels at the 2000 lb test weight to meet the 1975 levels with a 50% heavier vehicle. There were no particulate, smoke, or aldehyde emission problems associated with the engine which achieved lower emission levels than any other gasoline fueled engine without after-treatment ever tested by the Agency. Additional nitrogen oxide control was found to be required to reach the 1976 levels, but the vehicles tested did not employ devices or special calibration for NOx, carbon monoxide, or hydrocarbon control.

**33683** **APTIC NO. 56682**

Bockris, J. O M.

THE ELECTROCHEMICAL FUTURE. *In: Electrochemistry of Cleaner Environments. John O M. Bockris (ed.), New York, Plenum Press, 1972, Chapt. 1, p. 1-23.*

The future of electrochemistry in relation to transportation, metallurgy, sewage and rubbish disposal, and chemical analysis is speculated upon, and emphasis is given to its potential as a nonpolluting energy source as compared to that of fossil fuels. A change to nonfossil fuel powered transportation will be necessary even if a 95% cleanup of exhausts is achieved, and the climatic effects of increasing carbon dioxide or the concommitant effects of solid effluents will force technology to that direction as early as 1990. Electrochemical power cells for electric cars would be relatively nonpolluting, and the CO2 could be cut to one-half that for the same mileage by an internal combustion engine. The cost of driving electric cars on hydrogen, using fuel cells, is presently less than that of using tax-free gasoline; and it would be much less in one or two decades. Thermal pollution resulting from the need for atomic power stations in connection with electric transportation could be overcome based on relevant literature in atomic energy technology. Electrochemistry could also offer other nonpolluting advantages such as in the purification of metal ores where presently sulfur dioxide is an important pollutant. Large scale chemistry in general, if converted to electrochemistry, would improve in the antipollutive sense.

**33684** **APTIC NO. 56271**

Bondarenko, B. I., A. M. Svyatenko, V. F. Pekach, and B. S. Styskin

USE OF NATURAL GAS IN METAL OXIDE REDUCTION PROCESSES. *Text in Russian. Gaz. Prom., no. 6:39-41, 1972. 7 refs.*

A burner for the homogeneous conversion of natural gas with air was designed for work under diffusion-kinetic combustion conditions and the production of gas applicable for the reduction of metal oxides; the burner has a capacity of 500 cu m/hr. Since soot formation and coking were the main problems during the introduction of the burner into practice, special measures were taken to prevent soot and coke formation; the preheating temperature of the conversion components was increased (gas to 650 deg and air to 780 deg), the temperature in the core of the burner was increased, and the delivery of secondary methane eliminated. The rates of gas flow in the tunnel and the burner-reducing furnace line were increased, and pipelines were added to the gas and air pipelines for delivery of the steam into the reaction zone. The addition of steam into the gas pipeline before the heater proved effective. The overheating of the steam to 650 deg decreased the coking of the pipes in the gas heater. The parameters of conversion were determined experimentally. The hydrogen + carbon monoxide content in the conversion gases should be greater than 45 to 50% for iron ore reduction.

**33685** **APTIC NO. 56331**

Bosisio, R. G. and A. Foggia

MICROWAVE POWER FOR A CLEAN RAPID GROUND TRANSPORT SYSTEM. *J. Microwave Power, 7(3):169-179, 1972. 11 refs. (Presented at the International Microwave Power Institute Conference, Monterey, Calif., May 26-28, 1971.)*

A reference design to provide a high speed ground transportation system by means of microwave energy is described. The proposed system is suitable in situations that require both a rapid means of transport and a high passenger capacity over relatively long distances. This situation arises whenever large urban centers expand into each other to form a continuous inhabited region requiring strict pollution control measures. (Author abstract modified)

**33686** **APTIC NO. 56768**

Brocke, Werner

SULFUR DIOXIDE REMOVAL FROM WASTE GASES: A STATUS REPORT FOR EUROPE. *Pollut. Eng. Sci. Solut., Proc. Int. Meet. Soc. Eng. Sci., 1st, 1972, p. 233-267, 1973. 14 refs.*

Nine processes for waste gas desulfurization which are presently in use in Western Europe are reviewed. There are three physical adsorption processes which make use of carbonaceous adsorbents: the Reinluft process, the Sulfacid process, and the BF process. The first and third produce either sulfuric acid or sulfur, while the second produces sulfuric acid. The alkali absorption processes include: the injection of lime, hydrated lime, and a suspension of hydrated lime; the Bahco and Bischoff processes, which are continuous processes involving the use of lime, limestone, or hydrated lime; the Grillo-AGS process, which makes use of mixtures and compounds of magnesium and manganese oxides; and the EDF process, which makes use of ammonia. The SFGD process is a catalytic absorption process in which waste gases pass over cupric oxide on activated alumina at 400 C, forming $CuSO_4$. Similar processes, mainly using ammonia, lime or limestone, and activated carbon have been or are being developed in Eastern Europe. In general, under German conditions, 80% sulfur dioxide removal would result in additional costs of 0.06 to 0.15 cents/kWh for power generation. This would mean a 7 to 15% increase in power generation costs or a 2 to 5% increase in costs for electricity consumers.

**33687** **APTIC NO. 56327**

Cross, Sidney E.

EXHAUST GAS CLEANSING SYSTEM. *(Assignee not given.) U. S. Pat. 3,691,772. 4p., Sept. 19, 1972. 5 refs. (Appl. Oct. 29, 1970, 4 claims).*

An apparatus consisting of a combination condenser and muffler to reduce the hydrocarbon content of exhaust gases is described. The exhaust manifold of an internal combustion engine is connected to a header pipe that branches to parallel connected inlet ports of a liquid-cooled condenser and a muffler. The outlet ports of the condenser and muffler are connected in parallel to a tailpipe. A conduit section communicates between the interior of the muffler and the inlet port of the condenser, thereby enabling some of the gas acted upon by the muffler to be also treated by passage through the condenser. A substantial amount of HC material condenses in the condenser so that purified exhaust gas is delivered from the outlet port of the condenser to the tailpipe. Unlike other emission control devices, this apparatus does not interfere with the performance of the vehicle. (Author abstract modified)

**33688** **APTIC NO. 56370**

Decher, Reiner, Abraham Hertzberg, and Richard C. Corlett

A COMPOUND CYCLE EMPLOYING TWO-STAGE COMBUSTION TO REDUCE AUTOMOTIVE AIR POLLUTION. *Preprint, Society of Automotive Engineers, Inc., New York, 11p., 1972. 21 refs. (Presented at the Society of Automotive Engineers National Combined Farm, Construction and Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., Sept. 11-14, 1972, Paper 720736.)*

A compound engine concept is presented which has the potential of significantly reducing exhaust emissions. The cycle is based on a combination of components of the spark-ignition engine and the turbine and utilizes a two-stage combustion process involving fuel-rich combustion at high temperatures to reduce oxides of nitrogen formation; lean burning follows to eliminate unburned hydrocarbons in a thermodynamically productive manner. A thermodynamic analysis of the cycle and a comparison with the conventional Otto cycle is presented, and the combustion processes involved and methods for implementing the cycle in a practical manner are examined. The results indicate that a practical automotive power cycle with excellent part-load and transient response characteristics is possible via this approach. (Author abstract modified)

**33689** **APTIC NO. 56383**

Fadden, William J., Jr.

POLLUTION FREE ELECTRIC POWER AND WATER PRODUCING STATION UTILIZING THE KINETIC AND POTENTIAL ENERGY OF WATER WIND WAVES. *(Assignee not given.) U. S. Pat. 3,685,291. 11p., Aug. 22, 1972. 6 refs. (Appl. Oct. 1, 1970, 11 claims).*

A pollution-free electric power and water producing station utilizing the kinetic and potential energy of water wind waves is described. The station produces fresh water as a by-product of a dehumidification process. The station consists of a wave energy converter including a reception channel and an automatically adjustable standing wave basin, which augments the inherent potential energy of the waves by converting extant kinetic energy into potential energy. A wave energy extraction system made of a plurality of vertical chambers regulates the air and water levels. There is an exhaust manifold for collecting exhausted air under pressure, a refrigerant coil system for extracting water from the exhausted air, and a power conversion system for utilizing the exhausted air under pressure as the prime mover to create electrical energy. The process occurs at or near ambient temperature, thereby minimizing entropy increase loss in the entire system. This is the only system that utilizes the inherent kinetic and potential energy of waves to a maximum efficiency. (Author abstract modified)

**33690** **APTIC NO. 56679**

Gregory, D. P., D. Y. C. Ng, and G. M. Long

THE HYDROGEN ECONOMY. *In: Electrochemistry of Cleaner Environments. John O M. Bockris (ed.), New York, Plenum Press, 1972, Chapt. 8, p. 226-280. 60 refs.*

The impact on industry and society of a transition from fossil fuels to hydrogen as the basic source of stored energy is examined. Considerations presented are future $H_2$ production techniques; economic feasibility; characteristics in pipeline transmission; means for storing $H_2$ to provide short-term energy reserves; the use of $H_2$ as a conventional fuel for cooking, heating, vehicle propulsion, and the generation of electricity locally; the storage of electrical energy using $H_2$ fuel cells; the expanded use of $H_2$ as a chemical raw material; and the impact of its use on pollution of the environment. The absence of fossil- fuel combustion at nuclear electricity-hydrogen plants would eliminate the conventional chemical contamination of the air and water. The radioactive emission also would be minimized for the fusion-type reactor. A 5000 MW fusion plant would present about the same degree of radioactive hazard as a 5 kW fission plant in terms of volume of radioactive materials and the length of time that they would be retained by the human body. Nuclear electricity-hydrogen plants do, however, have a high potential for thermal pollution. The only practical location for such stations would be on the sea coast or on offshore platforms for removal of waste heat. The most significant difference in the use of $H_2$ as fuel would be the absence of a need for a flue; product gases consist only of water vapor. No carbon dioxide, carbon monoxide, or sulfur pollution would occur.

**33691** **APTIC NO. 56315**

Grobman, J. S.

EFFECT OF OPERATING VARIABLES ON POLLUTANT EMISSIONS FROM AIRCRAFT TURBINE ENGINE COMBUSTORS. *General Motors Research Labs., Proc. Emissions Continuous Combust. Syst. 1971, p. 279-321, 1972. 29 refs.*

Combustor research aimed at reducing emissions from jet aircraft engines is reviewed. Experimental results of tests performed on both conventional and experimental combustors over a range of inlet total pressure, inlet total temperature, reference velocity, and fuel-air ratio are presented to demonstrate the effect of operating variables on pollutant emissions. Combustor design techniques to reduce emissions are discussed. Improving fuel atomization by using an air-assist fuel nozzle significantly reduces hydrocarbon and carbon monoxide emissions during idle. A short-length annular swirl-can combustor has demonstrated a significant reduction in nitric oxide emissions compared with a conventional combustor operating under similar conditions. The use of diffuser wall bleed to provide variable control of combustor airflow distribution may enable the achievement of reduced emissions without compromising combustor performance. (Author abstract)

**33692** **APTIC NO. 56680**

Hammond, R. Philip

THE PROSPECT OF ABUNDANT ENERGY. *In: Electrochemistry of Cleaner Environments. John O M. Bockris (ed.), New York, Plenum Press, 1972, Chapt. 7, p. 207-225. 18 refs.*

The technical basis of future energy supplies and their socio-economic and environmental impact are explored. A comparison of the costs of various sources of energy illustrates economic advantages that would be associated with future fusion and breeder reactors. The burning of rocks such as granite, which contain 100 times as much energy as coal for a given weight, in breeder type fission reactors would release the energy of all the uranium and thorium in the fuel instead of only the small portion (1%) that is usuable in ordinary reactors. Perfection of the fusion reactor would allow for the utilization of sea water as an immense energy source. Half a cu mi of water would yield the total energy used by man to date. The fusion reactor appears to have a 20-yr development period ahead, while large scale versions of breeder reactors will be starting operation in the next 2-3 yr. Potential thermal pollution from these energy sources does not appear intolerable. A total man-made energy of 0.2 times 10 to the 12 kW with a budge of 20 kW per person and 10 times 10 to the 9 people would only be 1.7 times .001 of the earth s natural rate of heat loss. This would increase the earth s average temperature by about .10 C. Nuclear parks could be located offshore for adequate dissipation of heat.

**33693** **APTIC NO. 56678**

Henrie, T. A. and R. E. Lindstrom

HYDROMETALLURGICAL TREATMENT OF SULFIDE ORES FOR ELIMINATION OF SO2 EMISSIONS BY SMELTERS. *In: Electrochemistry of Cleaner Environments. John O M. Bockris (ed.), New York, Plenum Press, 1972, Chapt. 9, p. 281-291. 8 refs.*

Hydrometallurgical procedures for the recovery of metal and the treatment of sulfide ores for the elimination of sulfur dioxide emissions are presented. Process details are based on extensive laboratory and pilot-mill studies conducted principally on mercury, silver, and molybdenum ores, with parallel studies on antimony and copper ores. Extraction data obtained with liquid-solid separation show that the recovery of Hg is essentially independent of the liquid-solid separation technique used. Filtration of the tails, however, had the effect of decreasing salt loss to one-half that incurred using countercurrent decantation. Indications are that zinc minerals, such as sphalerite, will yield effectively to dissolution by an electrooxidation sequence. Research is also being conducted on nickel-cobalt sulfide ores and certain copper and antimony ores containing sulfide minerals. Electrooxidation during electrolysis provides a hydrometallurgical alternate to the smelting of sulfide ores and the consequent emission of SO2 gases to the environment. Product sulfur, in the form of sulfate, reacts with gangue constituents and is discharged as an innocuous component of the tails. Similarly, elemental sulfur, if formed at lower pH values, remains with gangue constituents.

**33694** **APTIC NO. 56668**

Kugaki, Takeo

HIGH TEMPERATURE GAS DUST COLLECTION BY WET COLLECTORS AND BAG FILTERS. *(Shisshiki oyobi baggu firuta ni yoru koon gasu no shujin). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 39(1):40-46, 1972.*

The use of wet dust collectors for high temperature gases creates many problems, but the recent trend is to use them for foundry cupolas. The reasons are: wet dust collectors are most often used for the cupola in the western nations; fluctuations of temperature of the cupola flue gas range from 200 to 1000 C and the cost for cooling for dry dust collectors is expensive; though the operation cost is relatively high, the period of use is relatively short and the installation cost is low; the wet method can also treat sulfur dioxide in flue gas. Some of the high performance dust collectors are described. Venturi rod hydrofilters utilize a high speed air current passed over wet surface of venturi pipes. Water is vaporized and drawn into the air current, collides with dust particles and collects it. The structure is extremely simple, and cleaning and inspections are easy. More energy is necessary for better efficiency. This method is suitable for mine kilns, cupolas, coke furnaces, dryers, and shell sand roasting furnaces. Bag filters are most widely used, but they are vulnerable to various gases; SO2 causes severe corrosion by sulfuric acid; carbon monoxide can cause inflamation, chlorine gas erodes the bag easily; and fluorine gas erodes glass fibers. For gas temperatures below 120 C, polyester and acryl can be used; for gases below 250 C, but above 120, glass fiber and teflon are suitable for the bag material. For cooling, the water method is the most economical.

**33695** **APTIC NO. 56760**

Kuronuma, Haruo, Yoichi Ito, and Raisaku Kiyoura

COMPOSITION OF V2O5-K2SO4 CATALYSTS DURING THE OXIDATION OF SULPHUR DIOXIDE. *(Nisanka io sanka hanno ni okeru V2O5-K2SO4 kei shokubai no sosei). Text in Japanese. Nippon Kagaku Kaishi (J. Chem. Soc. Japan), 8(6):1078-1084, June 1972. 12 refs.*

The composition of Vanadium Pentoxide-Potassium Sulfate catalysts during the oxidation of sulfur dioxide at low concentrations (0.2%) was investigated in order to study the mechanism of the reaction. Several hours were needed for the catalyst to reach equilibrium composition in the reacting gas; this was one of several reasons why the oxidation of SO2 generally required a longer time to reach the steady state. The effects of temperature on the absorbed volume of sulfur trioxide by the catalyst and on the V (5+)/V (5+) + V (4+) ratio were studied in the range between 320 and 520 C. The ratio and sulfur trioxide absorption volume changed greatly at a temperature of 400 to 450 C. These variations were correlated with a change in the reaction mechanism at the particular temperature. Catalytic activity, SO3 absorption volume, and the V (5+)/V (5+) + V (4+) ratio of the catalyst at working state were plotted against catalyst composition at a temperature less than 450 C, and these plots had inflection points in the vicinity of K2SO4/V2O5 equal to 1. This suggests that a catalytically active substance may exist in an equal molecular ratio of K2SO4 and V2O5 and that the mechanism of the oxidation of

SO2 is more complex than the proposed theory of K2S2O7 and VOSO4.

**33696** **APTIC NO. 56360**

Lowe, H. J. and J. Dalmon

DUST COLLECTION FROM PROCESSES. PART B: ELECTROSTATIC PRECIPITATORS FOR LARGE BOILERS INCLUDING COMBINATIONS WITH CYCLONES. *In: Processes for Air Pollution Control. G. Nonhebel (ed.), Cleveland, Ohio, CRC Press, 1972, Chapt. 13, p. 412-425. 12 refs.*

Electrostatic precipitation methods for removing solid particles from effluent gases of coal-fired boilers are reviewed. Removal of fly ash from flue gases is performed by two main types of electrostatic precipitation: tubular and plate. Large modern boilers are almost invariably provided with plate precipitators since it is difficult to obtain uniform gas distribution among tubes, re-entrainment of precipitated dust tends to be high, and tubular precipitators are difficult to rap effectively. The efficiency required of flue-gas cleaning equipment is largely determined by the size of the plant and by the chimney height. The effective migration velocity depends mainly on particle size and on the strength of the electric field between the electrodes; re-entrainment of precipitated dust will lower the average effective migration velocity. Precipitators are sensitive to gas velocity, and it is thus advisable to check the specified performance at both normal and low carbon dioxide operating conditions. It is necessary for gas distribution to be uniform is optimum performance is to be obtained from the precipitator; methods for controlling gas distribution usually consist of splitters or turning vanes at the beginning of the inlet valve followed by two or three perforated baffles immediately before the inlet zone. Effectiveness of rapping is mainly determined by the peak acceleration of the electrode in its own plane.

**33697** **APTIC NO. 56328**

Matkuch, John A.

ADDITIVE FEED CONTROL FOR AIR POLLUTION CONTROL SYSTEMS. *(Combustion Engineering, Inc., Windsor, Conn.) U. S. Pat. 3,693,557. 10p., Sept. 26, 1972. 2 refs. (Appl. July 8, 1971, 9 claims).*

A method and apparatus for controlling additive delivery to and circulation within an air pollution control system are described. The system controls the scrubber recycle flow rate and additive to fuel delivery ratio in response to an established pH operating level which may be varied within limits in response to the sulfur oxide content of the gas leaving the scrubber for optimum additive usage. Other systems rely upon an operator-established additive to fossil fuel feed ratio and an operator-established recycle flow rate for the aqueous medium in the scrubber. Such limited control is incapable of meeting problems particularly those in systems employing multiple scrubbers in parallel. (Author abstract modified)

**33698** **APTIC NO. 56737**

Mayer, E. A. and G. W. Hurlong, Jr.

STEAM CAR CONTROL ANALYSIS. (FINAL REPORT). *Bendix Corp., Southfield, Mich., Research Labs., Environmental Protection Agency Contract 68-04-0004, APTD-1545, 166p., July 1972. 5 refs.*

NTIS: PB 222349

A program was undertaken to develop a control system for a steam-car power plant; the final phase of the program aimed toward selecting the best control mode and experimentally verifying the soundness of the concept. The conventional closed-loop control of temperature and pressure is not satisfactory for the steam generator system, and the predictive control system with a closed-loop trim control in the temperature and pressure circuits can provide a satisfactory power plant operation. The analytical model of the power plant has been verified by comparison with experimental data obtained by Steam Engine Systems Corporation. The model has sufficient steady state and dynamic accuracy for detailed design of the control system. The simplified hardware implementation of the predictive-control system does not provide satisfactory control over a 20:1 range of steam flow; the details of a system capable of operation over such a range have not been developed. The computer program to date has developed an analytical tool that offers a realistic evaluation of the details of the control design; the complexity of control can be traded against component complexity. Recommendations for continued work are given. (Author summary modified)

**33699** **APTIC NO. 56363**

Nonhebel, G.

DUST COLLECTION FROM PROCESSES. PART C: PROBLEMS IN THE CEMENT INDUSTRY. *In: Processes for Air Pollution Control. G. Nonhebel (ed.), Cleveland, Ohio, CRC Press, 1972, Chapt. 13, p. 425-437. 5 refs.*

Air pollution problems in the cement industry are reviewed. There is considerable advantage to be gained in respect to air pollution by use of processes in which the amount of water in the feed to the kiln is kept to a minimum; it is also necessary to minimize the amount of in-leakage of air at various joints in flues, dust-arrester hoppers, and through holes formed by corrosion. Odor problems can be prevented by operating with 1-1.5% oxygen (dry basis) at the kiln gas outlet. There are three practical dust arrestors for cement flue gases: cyclones, dry electrostatic precipitators, and fabric filters using glass fiber fabrics. High-efficiency cyclones are reasonably satisfactory for small plants away from habitations, but efficiencies can drop to as low as 60% for very fine dusts. Electrostatic precipitators with two or three chambers in a series will reduce the effluent dust concentration to less than 0.24 g/cu m at which concentration thy dust plume is practically invisible. Dusts from mill vents are removed either by fabric filters, provided the air is maintained above the dew point or, in the case of cement, by electrostatic precipitators. Difficulties with dust leakage at transfer points along band conveyors may be solved by provision of a suitable casing under suction, leading to a fabric filter.

**33700** **APTIC NO. 56318**

Oberdorfer, Paul E., Jr.

MOTOR VEHICLE EMISSION CONTROL SYSTEM. *(Sun Oil Co., Philadelphia, Pa.) U. S. Pat. 3,685,502. 8p., Aug. 22, 1972. 10 refs. (Appl. March 4, 1971, 5 claims).*

A motor vehicle emission control system is described. Emissions from motor vehicle exhausts of oxides of nitrogen, carbon monoxide, hydrocarbons, and aldehydes are reduced by a combination of selective enrichment of the fuel air mixture fed by the carburetor to the engine, and an exhaust converter, e.g., a thermal exhaust reactor. The selective enrichment is carried out under low speed, mild acceleration (urban) driving conditions. Since exhaust gases are not recirculated in the system, catalysts are unnecessary, and the driveability of the car is not affected. (Author abstract modified)

**33701** **APTIC NO. 56673**

Pagni, Patrick J. and Lewis Hughes

SIZE DISTRIBUTIONS OF PARTICLES EMITTED FROM A MODEL COMBUSTOR. *California University, Berkeley, Calif., Coll. of Engineering. Rept. TS-72-8, WSCI-72-25, 7p., Oct. 1972. 12 refs.*

Size distributions of particles emitted from a gas turbine model combustor were studied to elucidate the mechanism by which additives reduce exhaust visibility and to determine whether the particle size distribution emitted by a model combustor could be presented by a power law such as n(r) equals cr to the minus b, where dN equals n(r)dr is the number of particles per unit volume with radii in the range r to r plus dr and b and c are constants. Electron micrographs of the collected particles were taken at a magnification of 20,000, and the particles were then sized and counted using a projected area equivalent radius as a measure of particle size. The power law approximately described the measured size distribution of the particles emitted by the model gas turbine combustor, and the observed range of the exponent, b less than 2, was appropriate to a coagulating, oxidizing aerosol. The additive, 2-methylcyclopentadienyl manganese tricarbonyl, altered the size distribution of particles emitted by the combustor to produce fewer large particles (greater than or equal to 0.2 micron) and many more small particles. This is consistent with observations that the additive increased the mass of particulate emissions while suppressing visible smoke.

**33702** **APTIC NO. 56685**

Potter, Edmund C.

THE ELECTROFILTRATION OF PARTICULATES FROM GASES. *In: Electrochemistry of Cleaner Environments. John O M. Bockris (ed.), New York, Plenum Press, 1972, Chapt. 5, p. 131-164. 42 refs.*

Principles of electrostatic precipitation are described in detail, and reference is made to the application and cost of electrofiltering dusts, mists, smoke, and fume as compared with other methods. Considerations presented are the Deutsch equation, particle migration velocity, the effect of applied voltage, the effect of particle size, the nature of the particle charging process, field strength distribution, electrical effects of suspended particles and collected dust, conditioning to counteract high resistivity of ash, and the structure and dislodgment of collected dust. Electrostatic precipitators are cheaper and more efficient than cyclones and do not have the increased power costs associated with pressure drop frequently encountered with fabric filters and scrubbers.

**33703** **APTIC NO. 56283**

Scherer, G. and L.-A. Tranie

EMULSION GENERATOR. *(Le generateur d emulsions). Text in French. Ind. Petrole, 40(6):33-35, June 1972. 4 refs.*

Physical aspects of the effect of water droplets on the soot formation in light fuel oil-burning domestic heating equipment, and a water-fuel oil emulsion generator designed for such a purpose are described. The water-fuel emulsion, containing 20% water, is obtained in a vibratory emulsion generator, featuring a membrane operated by high-speed fluid jet. The emulsion is atomized by a nozzle to obtain water droplets of about 10 micron diameter. Many of the water droplets thus obtained incorporate oil droplets which they bring to explosion into very small particles before they burn. The evaporation of the fuel oil droplets is also due to the cracking of the heavy fraction, and the fine cracked particles can burn practically completely in the gaseous medium. The addition of water finally results in the reduction of the amount of soot formed by 80% or more as compared to oil combustion processes, and it also permits reduction of the air excess ratio without increasing the smoke index. The use of oil-water emulsions in the described manner fails to influence the sulfur dioxide and nitrogen oxide formation. The combustion efficiency may increase by up to 3% through the use of oil-water emulsions.

**33704** **APTIC NO. 56732**

Schwartz, C. H., A. A. Orning, R. B. Snedden, J. J. Demeter, and D. Bienstock

DEVELOPMENT OF A VORTEX INCINERATOR WITH CONTINUOUS FEED. *American Society of Mechanical Engineers, New York, Proc. Natl. Incinerator Conf., New York, 1972, p. 145-154. 10 refs. (June 4-7.)*

The incineration of standard refuse and selected municipal refuse was studied by the Bureau of Mines in a pilot scale vortex incinerator. Designed for a capacity of 150 to 300 lb/hr of refuse, the incinerator has a refractory lining, a mechanical ram for continuous feeding, tangential-air firing, and provision for injecting secondary air to the center of the vortex. Air follows a helical path along the wall to the bottom where it contacts the bed of burning refuse. Gaseous combustion products spiral up through the vortex to the furnace outlet at the top. Secondary air is admitted to the center of the vortex just above the fuel bed to eliminate a previously encountered problem of incompletely burned particulates and volatile matter escaping in the flue gas. Auxiliary fuel (natural gas) was required to stabilize combustion when the moisture content of the municipal refuse exceeded 50%. Better than normal draft control was needed to minimize induced air flow through the feed tubes and the fuel bed. Mild agitation of the bed was needed to break a crusty ash from the standard refuse and to combat a tendency to carbonize with ram feed of the shredded domestic refuse. (Author abstract modified)

**33705** **APTIC NO. 56326**

Sheffield, Raymond A.

HOLLOW GRATE INCINERATOR. *(Anti-Pollution Incinerators, Cambridge, Mass.) U. S. Pat. 3,688,709. 6p., Sept. 5, 1972. 4 refs. (Appl. Nov. 3, 1970, 9 claims).*

A furnace that prevents air pollution while achieving complete combustion in an incinerator is described. The furnace has a hollow grate and a plurality of air passages around the combustion chamber through which combustion air is circulated, preheated, and used in the combustion of material to be incinerated. No other device cools the combustion chamber and prevents air pollution by circulating air around the combustion chamber in a plurality of layers. (Author summary modified)

**33706** **APTIC NO. 56749**

Stabenow, Georg

PERFORMANCE OF THE NEW CHICAGO NORTHWEST INCINERATOR. *American Society of Mechanical Engineers, New York, Proc. Natl. Incinerator Conf., New York, 1972, p. 178-194. 4 refs. (June 4-7.)*

The performance of the new Chicago Northwest Incinerator plant is described. The plant represents the first large scale refuse burning plant with heat utilization in the United States. The quantity of steam generated is directly proportional to the heat content in the refuse fed to the furnace. A running log of the refuse heating value is kept by recording the steam flow and the weight of the refuse received on a daily basis. Carefully conducted tests in Chicago indicate that the widely discussed continuously increasing heating value of municipal refuse appears to be overrated. During the 5-day testing period which was conducted during mild and dry weather the mean heating value (HHV) of the refuse hovered around 3900 to 4000 Btu/lb. Only during the second day of the efficiency test when especially dry refuse was delivered in an attempt to obtain the 5000 Btu/lb heating value, was the HHV increased to 4360 Btu/lb. Presently all steam generated is being converted back to water in the condensing system on the roof, but approximately 250,000 lb/hr will be available for sale. The balance of the steam is consumed by turbine drives for the majority of the auxiliary equipment as well as the plant heating system. A comfortable reserve margin of at least 10% overcapacity is available. The efficiency of the boiler and combustion is approximately 3% above the predicted value and the emissions of particulate matter into the environmental atmosphere is well within the specified limits. The incoming refuse volume was reduced to approximately 7% and emissions to the atmosphere within acceptable limits. (Author conclusions modified)

**33707** **APTIC NO. 56636**

Stebar, Russell F. and Robert L. Everett

NEW EMPHASIS ON FUEL VOLATILITY - EFFECTS ON VEHICLE WARMUP WITH QUICK-RELEASE

*CHOKES. Preprint, Society of Automotive Engineers, Inc., New York, 10p., 1972. 8 refs. (Presented at the Society of Automotive Engineers, National Fuels and Lubricants Meeting, Tulsa, Okla., Oct. 31-Nov. 2, 1972, Paper 720934.)*

The use of quick-release chokes was shown to greatly affect emissions and driveability for two 1971-model test cars. Carbon monoxide emissions for the first cycle of the 1975 Federal Emissions Test were reduced about 80% with an experimental fuel that provided good driveability. First-cycle hydrocarbon emissions were also reduced as much as 56%. Warmup driveability with quick-release chokes deteriorated drastically at moderate temperatures (40 and 68 F) using a commercial-type gasoline. Driveability, however, was essentially recovered with experimental gasolines by increasing fuel volatility in the 40-90% range of the ASTM distillation curve. Front end volatility (below 40% evaporated) had little effect on driveability at these temperatures. (Author summary modified)

**33708** **APTIC NO. 56267**

Syrota, J.

CHAPTER XII: THE CONTROL OF AUTOMOTIVE EMISSION-GENERATED POLLUTION. *(Chapitre XII: La lutte contre la pollution atmospherique causee par les vehicules automobiles). Text in French. Pollut. Atmos. (Paris), no. special:146-154, July 1972.*

Detailed descriptions are given of the methods available for the reduction of automotive exhaust emissions, and new, more or less tentative, technical solutions to vehicle propulsion are presented. Hydrocarbons in both crankcase and exhaust emissions, nitrogen oxides, chiefly nitric oxide and nitrogen dioxide, carbon monoxide, and lead particles are the main pollutants generated by gasoline engines, while diesel engines emit mostly small amounts of CO, NOx, HC, and carbon particles. Some 40% of all HC emissions from gasoline engines are originated in the crankcase and related systems, while the residual 60% are present in the exhaust gases. The HC and CO emissions can be abated by improving the combustion conditions, or using afterburning. Nitrogen oxides require temperatures around 1100 C for their formation. Fat mixtures usually give considerable CO and HC emissions and reduced NOx emissions. Idling and deceleration are chiefly responsible for CO emissions. Hydrocarbon emissions are generated mostly under acceleration conditions. Improvement of the combustion chamber geometry, and provision for a stratified layer are suitable for the abatement of CO and HC emissions. Catalytic reduction of NOx and oxidation of CO represents a delicate problem due to the poisoning effect of Pb. Exhaust gas recirculation leads to reductions of 30-40% in the NOx emission. Vehicles powered by battery, fuel cell, combinations of the former, by combinations of electric and internal combustion engines, vapor engines, stirling engines, and gas turbines permit more or less reduction of noxious emissions, but most of such designs lack practicability at the present time.

**33709** **APTIC NO. 56329**

Tatsutomi, Yasuo and Tomoo Takokoro

CONTROL SYSTEM FOR PURIFYING EXHAUST GAS OF AN INTERNAL COMBUSTION ENGINE. *(Toyo Kogyo Co., Ltd., Hiroshima-ken (Japan)) U. S. Pat. 3,685,295. 8p., Aug. 22, 1972. 7 refs. (Appl. March 10, 1970, 5 claims).*

A control system for purifying exhaust gas of an internal combustion engine is described. An air pump driven by the engine supplies secondary air through a conduit to the exhaust passage of the engine. The actuation of the ignition can be varied by delaying or cutting off the ignition at low vehicle or engine speed. Normal actuation of ignition is maintained over a predetermined speed while supplying a secondary air from the air pump to the exhaust passage within a predetermined low engine or vehicle speed, but secondary air is prevented from reaching the exhaust passage above a predetermined speed. Other systems supply the reactor with secondary air and allow unburned fuel components to be exhausted into the atmosphere. (Author abstract modified)

**33710** **APTIC NO. 56793**

Thom, N. G. and G. C. Howe

EXPERIENCE WITH AIR POLLUTION FROM HOT MIX ASPHALT PLANTS IN NEW ZEALAND. *Clean Air Society of Australia and New Zealand, Proc. Int. Clean Air Conf., Melbourne, Australia, 1972, p. 227-232. 2 refs. (May 15-18.)*

New Zealand s experience with the control of air pollution from hot mix asphalt plants and some factors influencing the emissions from these processes are reviewed. The main pollutants resulting from such operations are dusts resulting from driers, screens, and other activities; sulfur dioxide from the use of fuel oils in the burner; and odors from the drying of stone. The most significant source of dust emission is the rotary drier. Factors affecting the amount of dust which becomes gasborne are aggregate sieve size, temperature, gas velocity, feed rate, and rate of rotation of the drier. Cyclone dust collectors are often found in new installations, but experience has shown that these must be followed by a scrubber in order to meet New Zealand standards. Scrubbers fitted to many of the plants in New Zealand are not running to their full potential due to insufficient water and hence poor efficiency. Sulfur dioxide removal during the combustion of No. 2 diesel oil and No. 6 fuel oil has an 80% efficiency. Odor problems resulting from unidentified components in the stone drying stage have been overcome only by the installation of stacks of adequate height. A regular maintenance and replacement program is essential to adequate control of pollutants, and new plants should be able to comply with a maximum dust emission concentration of 230 mg/cu m.

**33711** **APTIC NO. 56392**

Vogel, G. J., E. L. Carls, J. Ackerman, M. Haas, J. Riha, C. B. Schoffstoll, J. Hepperly, and A. A. Jonke

REDUCTION OF ATMOSPHERIC POLLUTION BY THE APPLICATION OF FLUIDIZED-BED COMBUSTION AND REGENERATION OF SULFUR-CONTAINING ADDITIVES. (ANNUAL REPORT). *Argonne National Laboratory, Argonne, Ill., Chemical Engineering Division, U. S. Atomic Energy Commission and Environmental Protection Agency contract EPA-IAG-0020, 73p., 1972. 4 refs.*

NTIS: ANL/ES-CEN-1005; EPA-R2-73-253

Fluidized bed combustion was investigated as a means of removing, from the gas phase, nearly all of the atmospheric pollutants (sulfur and nitrogen compounds) generated during the combustion of fossil fuels. Particulate lime solids are introduced into the fluidized bed and react with the S compound formed during combustion. Information was obtained on pollution control by fluidized bed combustion of oil with an excess of air and by the combustion of coal with a deficiency of air, the thermodynamics of several proposed processes for regenerating additives, and experimental regeneration of S-containing additives, and by the two most promising processes--a one-step reductive decomposition of calcium sulfate and a two-step reduction-carbon dioxide/water regeneration procedure. (Author abstract)

**33712** **APTIC NO. 56362**

Ward, E. R.

SOLID CHEMICAL ABSORBENTS FOR GASES. PART A: REMOVAL OF HYDROGEN SULPHIDE FROM COAL GAS. *In: Processes for Air Pollution Control. G. Nonhebel (ed.), Cleveland, Ohio, CRC Press, 1972, Chapt. 8, p. 230-265. 22 refs.*

A review is presented of the use of solid chemical absorbents on a large industrial scale for the removal of hydrogen sulfide from coal gas and the catalytic removal of organic sulfur compounds from fuel gases. Topics covered include: the reactions involved in absorption of H2S; types of purifiers and ancillary plants; plants for the extraction of sulfur from spent oxide; choice of a dry purification plant (removal of H2S as iron sulfide in static bed, fluidized bed, shallow box purifiers, deep box purifiers, dynamic tower purifiers, static tower purifiers); factors affecting costs; basic data and plant design (maximum stream capacity, number of purifiers per stream, arrangement of purifier valves and connections, material layer depth in purifiers, direction of gas flow through purifiers, purifying material content of purifier streams); basic features of ancillary equipment; instrumentation for analysis of gas and measurement of gas pressure, temperature and flow, purifier erection and maintenance; process control; commissioning of a new plant; safety precautions; description of a modern, low pressure, dry purification plant; and catalytic methods for organic sulfur removal.

**33713** **APTIC NO. 56384**

Yermolayev, V. N.

STUDY OF THE HEAT EXCHANGE PROCESS OCCURRING UNDER HIGH PRESSURE CONDITIONS IN SCRUBBERS. *(Izucheniye teploobmena vysokogo davleniya v skrubbere). Text in Russian. Stal, vol. 8:769-771, 1972. 5 refs.*

Heat exchange processes occurring under high pressure in an unpacked scrubber between open hearth furnace gases and a water spray were studied. A scrubber of 5.5 m diameter and 18.5 m height was used for the experiment, and an operating pressure of 1.7 at 350 C gas temperature was adopted. The water expenditure ranged from 300 to 450 l/cu m of gas. The gas and water temperatures in the cross-section of and along the vertical axis of the scrubber were dependent on the quantity of the water and gas, on the temperature, pressure, and density of the gas, on the gas and water distribution in the cross section, and on the space coefficient of heat exchange. In the lower part of the scrubber (first heat exchange zone) the heat given off by the gas was consumed mainly for the evaporation of the water. Increasing vapor content of the gas with lowering gas temperature was observed. The enthalpy of the gas changed to a negligible degree, and the water temperature remained practically constant until the dew point was reaced. From the dew point on, both the enthalpy and the vapor content of the gas decreased with lowering temperature, and the water temperature rose. Scrubbers of reduced diameter were more effective than those of increased diameter. It is concluded from the experiments that non-packed scrubbers should be designed for a gas flow rate of 1.75-2 m/sec in the corss section, for a dwell time of 10-15 sec, and for an average space coefficient of heat exchange of 650 to 750 kcal/cu m/hr/deg C.

**33714** **APTIC NO. 56266**

Syrota, J.

CHAPTER XI: CONTROL OF COMBUSTION EQUIPMENT-GENERATED AIR POLLUTION. *(Chapitre XI: La lutte contre la pollution atmospherique des installations de combustion). Text in French. Pollut. Atmos. (Paris), no. special:127-145, July 1972.*

Comprehensive descriptions are given of the methods for controlling combustion equipment-generated air pollutant emissions with special regard to dust, sulfur dioxide, and nitrogen oxides. Improvement of the combustion equipment designs, qualification of heaters, and emission measurements are among the basic prerequisites of emission abatement. Dust and fly ash emissions, generated chiefly by large-capacity combustion equipment such as thermal power plants, can be effectively reduced by means of electrostatic dust precipitators which now reach efficiencies of 98% or higher. Nitrogen oxides form mostly at high combustion temperatures and at high air-excess ratios. The SO2 emissions can be substantially abated by the use of low-sulfur or desulfurized fuels, or by the removal of SO2 from the flue gases by the injection of dry additives such as dolomite or limestone; through oxidizing SO2 into sulfuric acid, as adopted in the Monsanto process; through SO2 adsorption on activated carbon; or flue gas scrubbing with magnesia, sodium carbonate or potassium carbonate solution. Various methods for the desulfurization of liquid fuels are described. Proper siting of large-capacity combustion equipment, the use of high stacks, and especially the creation of special zones around large-capacity combustion equipment, such as done in Paris, are essential for effective pollution control. In Paris, where in special protection zones the use of specific, pollution-prone fuels, and of fuel oils with high sulfur contents has been prohibited, decreases by 30% and 40%, respectively, in the SO2 and black smoke emissions from 1963 to 1969 were noted. Proper building insulation helps reduce combustion process-related air pollution due to a resulting fuel saving.

**33715** **APTIC NO. 56274**

Kurie, Eugene J.

ELIMINATE POLLUTION AND SAVE MONEY IN THE PROCESS. *Preprint, National Coil Coaters Assoc., p. 46-50, 1972. (Presented at the National Coil Coaters Association, Fall Technical Meeting, Chicago, Ill., Oct. 4-6, 1972.)*

A process for elimination of pollution through effective heat recovery is described. The Midland-Ross Total Heat Recovery Concept includes a series of heat recovery systems that are coordinated in a single unit, totally integrated with the coating line itself. A typical coil coating line includes one or more of the following: direct air recycling and indirect air to heat exchange, air to liquid to air heat exchange, air to liquid to liquid heat exchange, air to steam to air heat exchange, and air to steam with direct steam to steam heat exchange. The air to air and air to liquid to air systems are the most effective. Heat is transferred immediately with no moving parts and no interconnecting ducts. The main advantage is the elimination of all possibility of cross contamination. The air to steam requires a fume incinerator to the exhaust system, the return on investment for the total heat reclaim package including fume incinerators and their installation is less than 4 yr.

## 1971

**33716** **APTIC NO. 56312**

Bahr, D. W.

CONTROL AND REDUCTION OF AIRCRAFT TURBINE ENGINE EXHAUST EMISSIONS. *General Motors Research Labs., Proc. Emissions Continuous Combust. Syst., 1971, p. 345-373, 1972. 2 refs.*

Aircraft turbine engine exhaust emissions include carbon monoxide, unburned or partially oxidized hydrocarbons, carbon particulates, oxides of nitrogen, and sulfur oxides. Extensive engine evaluations have been conducted to determine the exhaust emissions characteristics of both production and development aircraft turbine engines. Combustors with virtually nonvisible smoke emission levels are being placed into service as a result of such research. More recently, efforts have been made to develop improved fuel atomization and primary zone stoichiometry control methods for reducing CO and HC emission levels. These investigations primarily involve the development of methods for improving combustion efficiency performance at low power operating conditions. Because the NOx emission characteristics of a given engine are directly related to its combustor inlet temperature levels, obtaining significant reductions in the levels of these emissions via combustor design techniques appears to be more difficult. Some degree of suppression is attainable by design approaches which involve improved control of the primary combustion zone stoichiometry and gas residence time. Reductions in the levels of these emissions are also attainable via the injection of water into the combustor. Extensive additional research and development efforts are still needed to provide NOx emissions abatement technology for use in turbine engines. (Author abstract modified)

**33717** **APTIC NO. 56391**

Breen, B. P.

OPERATIONAL CONTROL OF THE NITRIC OXIDE EMISSIONS FROM STATIONARY BOILERS. *General Motors Research Labs., Proc. Emissions Continuous Combust. Syst., 1971, p. 325-344, 1972. 5 refs.*

Nitric oxide formation is examined from the point of chemical kinetics, turbulent mixing, and the statistical nature of ignition/combustion phenomena. This is applied to a discussion of the practical ways in which the combustion related temperature histories and resultant nitric oxide may be controlled, particularly by use of the nonadiabatic characteristic of boilers. The means of temperature and NO kinetic control which were investigated include off-stoichiometric combustion, product gas recirculation, lowering air preheat, and water/steam injection. Each method of combustion profile control is discussed as it applies to large boiler systems and in term of the limits of application. A wide range of system parameters have been investigated, and the effects of boiler size, firing pattern, excess air operation, oil characteristics, and gas injection characteristics are discussed. A large amount of the present work was directed toward the extension of current plant operating data to predict new plant nitric oxide control. The way in which the wide variety of different current and proposed pollution control regulations apply to actual plants is shown. Finally, the atmospheric nonadiabatic combustor is shown to provide low emission characteristics in actual large scale operation through techniques which have wide range application. Future analytical modeling of the combustion processes and NO formation will point out further reductions and the equipment design direction which the nonadiabatic combustor must take. (Author abstract modified)

**33718** **APTIC NO. 56708**

Felgar, Donald N.

ELEMENTS OF AIR QUALITY. *In: Environment. Southern California Edison Co., 1971, 107p. 26 refs.*

A reference and teaching text for the Environmental Education Program at the Southern California Edison Co. is presented on elements of air quality. Types of pollutants considered are: sulfur oxides, particulate matter, carbon oxides, hydrocarbons, nitrogen oxides, and photochemical oxidants. Control measures described include: desulfurization of coal, oil, and natural gas; stack gas cleanup; combustion efficiency improvement; generating efficiency improvement; dispersion; new energy source location; source relocation; and source shutdown. Both stationary and mobile sources are covered. A detailed description is also given of the Southern California Edison s air pollution control program which includes equipment modification, variations is firing methods, filtering devices, scrubbers, and electrostatic precipitators. Future research and development is also outlined.

**33719** **APTIC NO. 56372**

Fornoff, L. L.

A NEW MOLECULAR SIEVE PROCESS FOR NOX REMOVAL AND RECOVERY FROM NITRIC ACID PLANT TAIL GAS. *Preprint, American Institute of Chemical Engineers, San Francisco, Calif. 12p., 1971. (Presented at the American Institute of Chemical Engineers Annual Meeting, 64th, San Francisco, Calif., Nov. 28, 1971.)*

A molecular sieve system known as the PuraSiv-N process has been developed to remove and recover oxides of nitrogen from the tail gas of a nitric acid plant. The system is capable of providing an NOx effluent concentration of less than 10 ppm vol, which is far below that which can be achieved with other known commercial systems. The treatment costs are 20% less than the treatment costs for a catalytic reduction system, while the capital investment costs are 28% higher. The PuraSiv-N system uses a unique molecular sieve adsorbent/catalyst which has been specifically developed to provide a long life in this application. The system has many processing advantages which are derived from the unique characteristics of the molecular sieve adsorbent/catalyst. (Author abstract modified)

**33720** **APTIC NO. 56469**

Jones, H. R.

REMOVAL OF MERCURY FROM GASES. *In: Mercury Pollution Control. Noyes Data Corp., Park Ridge, N. J., 15p., 1971.*

Several devices and processes are reviewed for removal of mercury from gases produced in Hg cell operation and for Hg removal from gases such as air. One process involves passing hydrogen gas contaminated with Hg vapor at a temperature below the boiling point of Hg through a bed of particulate adsorbent comprising silver metal on a fused aluminum oxide support at a rate sufficient to substantially reduce the Hg content of the gas. A device for absorption of Hg vapor from air comprises a chamber containing a porous absorbent which presents an extended surface of Hg-wettable metal. Mist eliminators which are currently being marketed can be used to recover Hg from hydrogen streams of Hg cell caustic chlorine plants and provide not only good pollution abatement but also high recovery of Hg. An activated carbon composition has been developed for the removal of Hg vapor from gases; improved operation is attained by impregnating materials which dissolve Hg on activated carbon. Another process involves removing Hg from a gas stream by passing the stream over an activated carbon impregnated with a metallic silver having a crystallite size of not over 250 A. A 2.78 g sample of the silver-impregnated activated carbon prepared according to the process had a breakthrough time of 19-26 hr at a space velocity of 11,000/hr.

**33721** **APTIC NO. 56727**

Kafarov, V. V., V. L. Perov, V. A. Ivanov, and D. A. Bobrov

OPTIMIZATION OF CHEMISORPTIVE PURIFICATION OF GASES. *Sov. Chem. Ind. (English translation from Russian of: Khim. Prom.), no. 5:346-350, May 1971. 13 refs.*

The cost of the chemisorption purification of a gas is a combination of the costs of the chemical reagents consumed, power consumption, and losses of the active portion of the chemisorbent. To determine the costs of the process and their optimization, it is necessary to calculate the operating conditions for the system as a whole. Mathematical models must be made for the individual devices, from which the system parameters are calculated using the block principle. The overall mathematical model of the system can be presented as a series of transform matrices of the individual devices, with the independent input variables from vector Y being isolated in the independent vector Y1. The general system expression is written in the form: (A1) (X1) equals (B) (Y1), where X1 is the vector of technological variables that characterizes the flows between devices, Y1 is the vector of independent variables; and A1 and B are the matrices of coefficients, derived from the transform matrices of the individual devices. A system of algebraic equations is presented which determines the connection between the technological parameters of the process and its solution on a computer. The application of this model was illustrated for a system for the chemisorptive removal of carbon dioxide from pyrolysis gas by ammonia water, with subsequent final purification by a sodium hydroxide solution.

**33722** **APTIC NO. 56377**

*Miesse, C. C.*

*TRAFFIC CONTROL FOR ENVIRONMENTAL QUALITY. Inst. of Environmental Sciences, Mount Prospect, Ill., Proc. Inst. Environ. Sci., Annu. Tech. Meet., 17th, Los Angeles, Calif., 1971, p. 4-8. 6 refs. (April 26-30.)*

The relationship between vehicle speed and carbon monoxide emissions is discussed. The CO emission rates from automotive exhaust, in terms of mass per mile of travel, can be approximated by an inverse variation with vehicle speed, and a direct variation with vehicle weight. Atmospheric pollution can be reduced substantially by increasing the average speed of traffic. An immediate improvement in the quality of the atmospheric environment can be effected by designation of additional arteries during peak hour traffic. Reductions of 13% to 22% in traffic-generated air pollution can be achieved by increasing the arterial speed limits from 40 mph to 60 mph. (Author conclusions modified)

**33723** **APTIC NO. 56657**

Sawyer, Robert F.

CENTRAL POWER PLANTS. *In: Combustion-Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 275-290. 5 refs.*

Fossil-fueled power plants rank third among contributors to air pollution in the United States ane emit approximately 25% of the particulates, 46% of the sulfur oxides, and 25% of the nitrogen oxides which are released each year into the atmosphere. They are minor contributors of carbon monoxide and hydrocarbons. The pollutants emitted depend largely upon the fuel burned and the furnace design. Removal of sulfur dioxide is accomplished either by use of low-sulfur fuel or by treating the flue gas; the limestone scrubbing process is closest to commercial application among the latter, though no optimum method has yet been identified. Three general types of dust collecting are employed for the removal of particulates: cyclone separation, wet scrubbing, and electrostatic precipitation. Electrostatic precipitators with efficiencies in the 99% range are possible and are probably the most attractive devices. Reduction of nitric oxide appears possible through modification of the furnace combustion process; burner designs have been successfully altered in existing furnaces through redistribution of the mixture ratio. The problem has been greatest with the use of natural gas as a fuel.

**33724** **APTIC NO. 56364**

Turner, David W., Robert L. Andrews, and Charles W. Siegmund

INFLUENCE OF COMBUSTION MODIFICATION AND FUEL NITROGEN CONTENT ON NITROGEN OXIDES EMISSIONS FROM FUEL OIL COMBUSTION. *AICHE Symp. Ser., 68(126):55-65, 1971. 1[illegible] refs.*

A study was conducted to determine the extent of fuel nitrogen conversion and the degree of nitrogen oxide control possible with combustion modification was determined. Experiments with distillate and residual fuels indicated that 40-80% of the fuel N2 depending on concentration, is converted to NOx during combustion under normal operating conditions. This accounts for 100-200 ppm NOx at normal residual fuel N2 contents of 0.1-0.4% and less than 30 ppm with normal distillate fuels. Flue gas recycling was found to be very effective in reducing NOx due to thermal fixation but had little or no effect on fuel N2 conversion. Simulated two-stage combustion, however, appears to have excellent potential for reducing both fuel NOx and thermal NOx to very low levels. (Author abstract modified)

**33725** **APTIC NO. 56306**

Wakasugi, Mikio and Yoshio Tsushima

JAPANESE FIRMS COMBINE TO INSTALL NEW DESULFURIZATION PROCESS. *Oil Gas Intern., 11(8):62-63, 65, Aug. 1971.*

Three Japanese companies have cooperated in the full-scale trial installation of the Wellman-Lord desulfurization process. The importation of crude oil by Japan has increased considerably, with over 90% of these oils containing large amounts of sulfur. The heavy fuel oils distilled from these crude products usually contain over 2% sulfur. The most feasible means of lowering the air pollution emissions from these oils is wet system flue gas desulfurization. Of the wet system processes, the Wellman-Lord process is best suited to large capacity plants. The SO2 in the flue gases of such plants is 90% removed by a prescrubber, which brings the gases into contact with sodium sulfite. The absorbing solution is then treated to produce a harmless diluted sodium sulfate. This process offers the advantages of comparative reduced costs, small space requirements, and reduced consumption of materials. In that the gas derived from the Wellman-Lord plant contains steam as its only impurity, sulfuric acid plants designed for treating such gases can be of simpler design than conventional sulfuric acid plants. Although there is some unreacted SO2 in the exhaust gas from the sulfuric acid plant, it is returned to the sulfur recovery unit for further processing.

## 1970

**33726** **APTIC NO. 56287**

Emmerich, Charles W.

AIR POLLUTION CONTROL PERTAINING TO THE LIGHT WEIGHT AGGREGATE INDUSTRY. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 73-79, 1970. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

Methods for control of air pollution resulting from the processing of shale through rotary kilns in the light weight aggregate industry are considered. Initial and operating costs, operating parameters, and efficiencies are listed for cyclones, spray towers, cyclone spray towers, impingement scrubbers, venturi scrubbers, bag filters, and electrostatic precipitation. The most recent refinement to air pollution control in light weight industry is the fabric bag collector. Advantages of fabric collectors are: collection efficiency, invisible effluent, and dry collection of particulates. Initial cost is relatively high, and provisions may be necessary for cooling the process gas from kilns. Electrostatic precipitators have not been used to any great degree in the United States, but two are reported being used abroad and quite successfully. Wet scrubbers have been used in conjunction with mechanical cyclone collectors which only collect large particulates, but they have several disadvantages: visible plume, high water consumption, increased pressure drop, freezing weather problems, and water pollution problems. Sources of fugitive type dust are: mining and grinding operations, hauling vehicles, and mine roads.

**33727** **APTIC NO. 56289**

Franklin, David M.

AIR POLLUTION AND WASTE CONTROL IN THE WOOD INDUSTRY. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 61-66, 1970. 2 refs. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

Collection, conveying, and disposal of wood waste are reviewed in relation to prevention of air pollution. Various types of dry cyclones are available on the market and are usually suitable for all but the most highly populated areas where more efficient collection devices such as bag filters may be required. The bag filter is one of the most efficient types of collection available and is in wide use in the secondary wood industry. Pollution from conveying equipment can be minimized by enclosure of the conveyor to prevent material from being blown by wind and to prevent excess moisture which renders waste more difficult to burn. The quickest, easiest, most economical method for disposal of wood waste is the wigwam or tee pee, although the chances of exceeding allowable state pollution levels with such devices appear to be about 100:1. Air pollution control for wigwams is usually achieved by one of four processes: an afterburner, a wet cap or washing chamber in the incinerator dome to remove coarse particles by scrubbing, the Lausmann process which is a type of secondary or afterburning, and improvement in combustion and draft patterns. The last method has been the most successful to date and is a relatively low cost method for obtaining approval in many states. It usually takes from 15 min to over an hour to reach temperatures high enough to burn the smoke particulates, while most states have written limitations from 5-20 min. However, this has been waived in many states, recognizing the fact that the overall result is going to yield less pollution from the wood industry. Manufacturers are currently working on gas firing or ignition to eliminate the start-up time, with the dome damper automatically adjusted.

**33728** **APTIC NO. 56739**

Jackson, W. E.

THE CONTROL OF AUTOMOBILE EMISSIONS. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 92-124, 1970. 14 refs. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

Control of automotive emissions are considered in relation to smog formation, emission characteristics of the internal combustion engine, emission controls which are currently in use or proposed, and automotive emission testing. Hydrocarbons have been reduced by 83% and carbon monoxide emissions by 70% from precontrolled levels (450 and 1370 lbs/car/year) prior to 1963. The two common approaches to exhaust control are the engine modification and the air injection systems. A 60% reduction in oxides of nitrogen can be achieved with 12% recirculation of exhaust gases. Three different catalyst systems have been proposed for exhaust treatment: the first promotes oxidation of hydrocarbon and carbon monoxide in a lean atmosphere; the second operates in a fuel rich atmosphere to reduce nitric oxide with either carbon monoxide or hydrogen; and the third is intended to control all three constituents simultaneously at chemically correct mixtures. Test results by Ford have been promising, but many technical problems, including durability, still exist. Systems for the control of crankcase and evaporative emissions have been in use for some time, and a reduction in fuel volatility is being considered to achieve a still further significant reduction of the latter. Data are presented for smog (oxidant level) indications of various major cities, effect of air-fuel ratio on exhaust emissions, effect of spark advance on exhaust gas hydrocarbon concentration, the California Chassis Dynamometer Schedule for hydrocarbons and carbon monoxide, nitric oxide emissions at various air-fuel ratios and ignition timings, and percent exhaust gas recirculation vs. percent NOx reduction. Illustrations and descriptions are also provided for emission testing devices.

**33729** **APTIC NO. 56297**

Kelley, T. E.

THE ROLE OF INDUSTRY. *Preprint, Louisiana Tech Univ., Ruston La., Continuing Engineering Education Div., p. 150-158, 1970. 1 ref. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

The role of industry in abatement of air pollution is reviewed, and illustrations and descriptions are provided for basic air pollution control devices. The basic clean air practices of responsible industry set forth are: collecting all economically recoverable material, obeying the law, being a good neighbor, sharing pertinent technical knowledge, participating in the formation of regulations, and doing basic research on unique or future problem areas. Devices which, if uniformly and correctly applied, can make a giant step toward clean air include: settling chambers, inertial separators, centrifugal separators, scrubbers, cloth bag filters, electrostatic precipitators, catalytic oxidation, incineration, and absorption.

**33730** **APTIC NO. 56767**

Kirby, T. W.

PROTECTION OF AIR QUALITY BY THE OIL INDUSTRY. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 134-149, 1970. 26 refs. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

Specific sources, the significance of the contaminant, and methods being used or likely to be used for its control are reviewed for sulfur oxides, carbon monoxide, hydrocarbons, particulates, and nitrogen oxides in relation to protection of the air quality by the oil industry. More sulfur plants are being constructed to recover hydrogen sulfide as sulfur; more acid sludge is being converted to fresh sulfuric acid; and sulfuric acid plants are being upgraded so that less sulfur dioxide is lost to the atmosphere. Fuel products are being desulfurized at the refinery, and low sulfur fuels are burned to the extent that they are available. Each year more petroleum refineries are installing carbon monoxide boilers to reduce the amount of CO released to the atmosphere. Storage tanks are potentially the most important source of hydrocarbon emission in the industry, and light hydrocarbons are held in pressure storage. It is also becoming a more frequent practice to recover hydrocarbon releases or to vent them to the fuel gas system. All of the usual methods for removing particulates from the gas stream may be found in different plants, and the practice of burning acid sludge as a means of disposal is losing favor. Catalytic reduction of nitrogen oxides occurring in flue gas to nitrogen has been attempted on an experimental basis, though the process is far from being ready for general use.

**33731** **APTIC NO. 56296**

Osmun, William G.

THE REDUCTION OF POLLUTION BY JET AIRCRAFT. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 125-133, 1970. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

Achievements in the reduction of smoke emissions from jet aircraft are reviewed. Abandonment of water injection to increase takeoff thrust and introduction of turbofan engines has significantly reduced takeoff smoke, and the newest wide body jets produce virtually no visible smoke plume. Among some 312 new aircraft to be delivered to the scheduled airlines during the 1970-1075 period, 265 will be virtually smoke-free wide body jets, representing an investment of $5.5 billion, or 95% of the industry s $5.8 billion for all new aircraft during this period. A decision in 1965 to concentrate on reducing smoke from the Pratt and Whitney JT8-D engine which is employed on aircraft operating on short route segments and thus creating the most smoke emissions has resulted in a reduced smoke combustor design; retrofitting has been scheduled for completion by the end of 1972. A comparison of sources of emissions in the United States shows that aviation accounts for only 3.3% of the total, representing 69 lbs of emission per individual.

**33732** **APTIC NO. 56697**

Reedy, D. E.

CATALYTIC OXIDATION OF ODORS. *Missouri Univ., Columbia, Coll. of Engineering and Missouri Air Conservation Commission, Jefferson City, Proc. Air Pollut. Conf.*

*Contr. Dusts, Smokes, Noxious Odors, 3rd Annu., 1970, p. Isl to I-9. 2 refs. (Nov. 17.)*

Catalytic oxidation of odors at lower temperatures of 600-900 F is economically more advantageous than incineration at 1000-1500 F. The type of catalyst and process and mechanical considerations are important in the design of a catalytic incinerator for odor control. Process performance is determined by time, temperature, and turbulence. These variables can be used to determine the chemical reaction rate by mathematical analysis. Thermal and catalytic reaction rates for maleic anhydride are compared. Catalytic oxidation rates for solvents are shown. Oxidation of mixtures, the effect of aging on catalyst activity, the thermal incinerator design are mentioned. The capital costs of the catalytic incinerator are 3-8 $/standard cu ft/min, and annual costs are 0-4500 $/1000 standard cu ft/min. A heat exchanger will add 30-50% to the initial cost of the system, but savings in operating costs will frequently return the investment in 3 years.

**33733** **APTIC NO. 56692**

Russel, R. A.

FUELS COMBUSTION AND AIR POLLUTION. *Missouri Univ., Columbia, Coll. of Engineering and Missouri Air Conservation Commission, Jefferson City, Proc. Air Pollut. Conf. Contr. Dusts. Smokes, Noxious Odors, 3rd Annu., 1970, p. E-1 to E-12. (Nov. 17.)*

Control of the combustion process and collection of fly ash are mature technologies which can best be applied to large fuel burning installations. Combustion control is justified by the operating economies achieved by its use, and pollution control considerations can do little to increase this application. Fly ash collection has some desirability in reducing plant maintenance costs, but its primary impetus must come from air pollution considerations. Electrostatic dust collector use should be aimed at high standards of day-to-day performance. Collection efficiency of mechanical collectors is in the range of 75-90% of the fly ash enterine the collector. Electrostatic precipitator efficiency is 99%. The mechanical collector would thus emit 100 tons/day, while the electrostatic collector would emit 6 tons/day. Coal combustion in electric power production is emphasized. (Author summary modified)

**33734** **APTIC NO. 56288**

Spruill, Edgar L.

AIR POLLUTION CONTROL IN AN INTEGRATED KRAFT MILL. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 67-72, 1970. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

A description and flow diagram of a representative kraft mill are presented, and factors relating to control of air pollution from various stages of the process are considered. Particulate emissions are the greatest of kraft mill emission problems, and these arise from the bark disposal boiler, the recovery furnace, and the lime kiln. The recovery boiler is the most important source of particulate (as well as gasoues) emissions and is required to accomplish conflicting goals. Complete oxidation of odorous reduced sulfur gases requires adequate oxygen content in the oxidizing zone, but minimum excess air is desirable to reduce particulate losses. Venturi scrubbers and electrostatic precipitators are used for removing the particulates, with the latter being more popular since dry recovery is desired. Offending gaseous emissions from kraft mills include mercaptans and sulfides. Odor emissions from digester venting and liquor flash can be reduced by minimizing the release of steam and the contact of non-condensibles with spent liquors. The discharge of odor can be largely eliminated by piping the vent gases to a kiln or furnace where the sulfur gases can be burned to $SO_2$, which is negligible at the low concentrations involved. Oxidation of the liquor with air, prior to contact with hot furnace gases, will largely prevent odor release from recovery furnaces. Technology now seems available to permit overall emission levels within the next few years of less than one pound of total reduced sulfur gases per ton of production.

## 1969

**33735** **APTIC NO. 56698**

Bapseres, P.

SCRUBBING FLUE GASES IN THE LACQ COMPLEX. *(L epuration des fumees dans le complexe de Lacq). Text in French. Tech. Moderne, vol. 61:313-316, Aug.-Sept. 1969.*

Procedures for recovering sulfur compounds at the Lacq complex in France are discussed, including thermic treatment, absorption by liquids, formation of sulfuric acid, and cyclic procedures with solid absorbents. The Lacq complex produces a fuel gas containing hydrocarbons, hydrogen sulfide, carbon oxides, and water. Desulfurization is attained by the Claus reaction. The flue gases contain 0.0005% $H_2S$, 0.6% sulfur dioxide, 10% carbon dioxide, 30% water, and 59.4% nitrogen. Recovery of $SO_2$ in the form of $H_2SO_4$ occurs by catalytic oxidation at 400 C or by $SO_2$ absorption in a solution containing iron and manganese salts. The best known cyclic absorption methods are the Reinluft Process and the Alkalized Alumina Process. Flue gases from the incineration during the humid catalysis method consists of $H_2S$, $SO_2$, $H_2O$, oxygen, $CO_2$, and nitrogen. The humid catalysis method produces up to 94% $H_2SO_4$.

**33736** **APTIC NO. 56431**

Roberts and Schaefer Co., Chicago, Ill.

DESIGN AND COST ANALYSIS STUDY FOR A PROTOTYPE COAL CLEANING PLANT (VOLUME II). *National Air Pollution Control Administration Contract PH22-68-62, APTD-0605, 176p., 1969.*

NTIS: PB 220701

The design, fabrication, and erection of a Coal Pilot Testing Plant for sulfur reduction are described. The plant is considered water and air pollution free under available federal and state regulations. The plant is using all wet cleaning processes and is operated on a closed circuit basis. A few dry coal handling points before the coal is wetted in the plant will be covered and dust collecting equipment will be provided for cleaning the exit air. The sulfur content of raw coal will be reduced to the best level in the clean coal with the consideration of the overall economy including the yield of clean coal and initial and operating costs of the process. The established levels of S content in clean coal are less than 1.0%, 1.01-1.50%, 1.51-2.00%, 2.01-2.50%, and greater than 2.50%.

## 1968

**33737** **APTIC NO. 56766**

Averbukh, T. D., N. P. Bakina, A. A. Radivilov, L. V. Alpatova, and E. A. Kravchenko

PRODUCTION OF ELEMENTAL SULFUR BY REDUCTION OF SULFUR DIOXIDE WITH NATURAL GAS (METHANE PROCESS). *(Polucheniye elementarnoy sery vosstanovleniyem dvuokisi sery prirodnym gazom (metannyy protsess)). Text in Russian. Khim. Prom., 1968:753-757, 1968. 25 refs. (Translation also available from National Translation Center as 72-15042-07A.)*

The kinetics of the thermal reduction of concentrated sulfur dioxide to elemental sulfur with natural gas (methane process) was studied in laboratory tests. With an $SO_2$:methane ratio of 1.9, both the rate of $SO_2$ conversion and the rate of S output were strongly dependent on the temperature. These rates were about 94% and 81% at 1100 C and with a reaction time of 3 sec, or at 1250 C and a reaction time of 1.4 sec, while the respective rates at 900 C and a reaction time of 14.4 sec were only 83% and 45%. Strong dependence on the rate of $SO_2$ conversion and of hydrogen sulfide output on temperature at a SO2:CH4 ratio of 1.27 was observed. Precipitation of carbon at 900 C was observed, but it ceased at a temperature of 1250 C. With a SO2:CH4 ratio of two and reaction times ranging from 0.34 to 12.9 sec, the overall rate of SO2 conversion reached 90-95% for 20 to 40% SO2 concentration, and 80-88% for 10% SO2 concentration. The elemental S output was 15-20% lower than the rate of SO2 conversion, and the H2S output ranged from 10 to 20%. The rate of SO2 reduction with methane in a temperature range of 850-1000 C was controlled by the rate of methane pyrolysis. The availability of SO2 of high concentration, as generated by nonferrous metallurgical processes, and of low-cost natural gas are among the basic prerequisites for the economy of the methane process.

### 1964

**33738** **APTIC NO. 56677**

Dunk, G. von der, H. Dembeck, and G. Ober

PROCESS FOR REMOVAL OF CYANIDE FROM TOP GAS WASHING WATER WITH THE USE OF POLYPHOSPHATES. *(Verfahren zur Entzyanisierung von Gichtgaswaschwasser unter Verwendung von Polyphosphaten). Text in German. Stahl Eisen (Duesseldorf), 84(5):259-264, Feb. 27, 1964. 18 refs. (Translation also available from TRANS-CHEM, Inc., P. O. Box 6219, Knoxville, Tenn. 37914, as C213798.)*

A technique to remove cyanide compounds from top gas washing water using sodium hexametaphosphate is presented. Water-soluble alkaline compounds reach the washing water during the blast furnace process. Carbonates, chlorides, and sulfates predominate with a small amount of cyanide which forms by the reduction of potassium carbonate in the presence of carbon and nitrogen and which dissolves during wet purification. Cyanide removal can be achieved by: the addition of acid and blowing off the resultant hydrocyanic acid; oxidation of cyanides to cyanates or nitrogen; or the precipitation of cyanides in the form of insoluble complexes. Polyphosphates are used in the threshold seeding technique to prevent rapid hardening of circulating water. Polyphosphates inhibit the formation of calcite, a hardening constituent. Solid material, conductivity, pH values, and hardening constituents are discussed with respect to their interdependence. Cyanides thus hydrolyze to hydrogen carbonates and ammonia under prevailing working conditions with clearance below 0.1 g/cu m. Cyanide concentrations can be surveyed by measurement of potential difference between a silver and reference electrode dependent on cyanide content.

### 1945

**33739** **APTIC NO. 56771**

Jares, Joseph

FUME DISPOSAL SYSTEMS. *Am. Paint J., 34(4):30, 32, 34, Oct. 22, 1945.*

Fume disposal systems for the paint and varnish industries, as well as fumes, their characteristics, rate of evolution, and basis of disposal are discussed. The various fume constituents given off during heat processing of oils and varnishes are described and show the variations in fume composition for the four major classes of products: bodying oils, running natural gums, manufactured oleoresinous varnish, and manufactured alkyd varnish. The same fume vapors are arranged into three major groups according to their approximate solubilities in water, alkaline solutions, and organic solvents. The physical form of the material at normal room temperature and the respective quality of odor are given. Examples of the rates of fume evolution and thinning losses of solvents which were collected to determine the peak load of a gas fired incinerator are given. The essential factors that should be considered first singly and then collectively in determining the period of maximum fume generation are given. The major items of equipment required for installation of either system are described.

### 1940

**33740** **APTIC NO. 56418**

Peysakhov, I. L. and B. A. Chertkov

PURIFICATION OF FLUE GASES FROM SULFUR DIOXIDE. *(Ochistka dymovykh gazov ot sernistogo angidrida). Text in Russian. Zh. Khim. Prom., 17(10):6-14, 1940.*

The magnesite and acid catalytic methods for the removal from flue gases and subsequent recovery of sulfur dioxide are described. The flue gases, previously purified from fly ash in electrostatic precipitators at an efficiency of 90-97%, are passed through a scrubber in which wash liquid with magnesite is used. The magnesium sulfite crystals growing in the wash liquid are separated in a Dorr separator, and decomposed at 800-1000 C to obtain magnesia and SO2 in a concentration of 7-8% which is suitable for SO2 production. At an initial SO2 concentration of 0.25%, and a wash liquid pH value of 6-6.1, an SO2 separation efficiency of 97-98% was attained. The optimums determined for the gas flow rate and spray density are 0.4-1.8 m/sec and 5-40 cu m/sq m of scrubber cross section. To permit production of more concentrated H2SO4 from absorbed SO2, manganese sulfate was replaced by pyrolusite, consisting mostly of manganese oxide, in the acid catalytic method of flue gas purification. The H2SO4 concentration attained with manganese oxide in bubblers and scrubbers was 18-20%. Such dilute H2SO4 can be used for various industrial processes, for superphosphate production, or it can be concentrated to 75-80% by evaporation.

## MEASUREMENT METHODS

### 1973

**33741** **APTIC NO. 56942**

Abramova, Yu. V.

PHOTOMETRIC DETERMINATION OF PARAOXYPHENYLMETHANE DIMETHYLVINYLETHINYL IN THE AIR. *(Fotometricheskoye opredeleniye dimetilviniletinil paraoksifenilmetana v vozdukhe). Text in Russian. Gigiena i Sanit., no. 8:68-69, 1973. 1 ref.*

A spectrophotometric method for the determination of paraoxyphenylmethane dimethylvinylethinyl in the air is described. Air samples are taken in two series of absorbers filled with a water-alcohol solution at a suction rate of 0.5 l/min. The sample is then combined with mercury nitrate obtained by dissolving mercury oxide in nitric acid. The color reaction is best at 50 C temperature. The coloration remains stable for 6 hours. The absorption peak for the spectrophotometric determination lies at 405 nanom. Quantitative determination is possible against a calibration curve. Phenol and dimethylvinylethinylcarbinol in amounts of up to 1 mg in the sample fail to interfere with the determination.

**33742** **APTIC NO. 56810**

Adams, D. F., J. O. Frohliger, D. Falgout, A. M. Hartley, J. B. Pate, A. L. Plumley, F. P. Scaringelli, and P. Urone

TENTATIVE METHOD OF ANALYSIS FOR SULFUR-CONTAINING GASES IN THE ATMOSPHERE (AUTOMATIC METHOD WITH FLAME PHOTOMETER DETECTOR). *Health Lab. Sci., 10(4):342-348, Oct. 1973. 12 refs.*

An automated analyzer for the continuous detection and determination of sulfur compounds in the atmosphere is described.

**It is applicable for the determination of sulfur dioxide only if it is known that other sulfur compounds do not exceed 5% of the $SO_2$ concentrations. Air is drawn through a probe into a hydrogen-rich flame at a constant rate. Upon entering the flame, the sulfur compounds at converted to $S_2$ excited state, which is at a higher energy state. When these molecules return to the ground state, they emit light of a characteristic wavelength which passes through a narrow-band optical filter and is detected by a photomultiplier (PM) tube. The current produced in the PM tube is amplified by an electrometer, and the magnitude of the response is displayed on a device such as a potentiometric recorder. The sensitivity and range of the method is discussed, as are interferences, the precision and accuracy of the method, the apparatus and reagents required, the necessary calibrations and standards, the calculation procedure, and the effects of storage.**

**33743** **APTIC NO. 56955**

Amaya, Kazuo

THE $SO_2$ SENSOR ELIMINATING INFLUENCES OF $NH_3$. *(Anmonia no eikyo o torinozoita $SO_2$ sensa). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):257, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 12.)*

The presently used electroconductivity sulfur dioxide meter is easily influenced by ammonia, which may in some cases reduce the measurement of $SO_2$ up to 66%. An absorbent containing dilute sulfuric acid and hydrogen peroxide, and another absorbent with the same amount of dilute sulfuric acid but without hydrogen peroxide were prepared. Equal amounts of air were passed through the two absorbent and the difference in electroconductivity was measured.

**33744** **APTIC NO. 56912**

Barde, R.

THE USE OF A FLY ASH SAMPLING PROBE. *(Utilisation d une sonde de prelevement de cendres.) Text in French. Rev. Gen. Thermique Paris, 12(141):815-819, Sept. 1973.*

A probe for fly ash sampling in overheaters of steam generators for studying the corrosive properties of fly ash and its interactions with the surface is described. The probe temperature had no influence on the composition of the deposits. The corrosion hazards of the fly ash are determined by measurement of the fusibility by means of differential thermal analysis, by the difference between the initial fusion temperature and the operating temperature of the metal source, as well as by the presence of corrosive substances in the fly ash. The injection of dolomite into the combustion chamber neutralized part of the sulfur trioxide, while the combustion of a fuel containing 120 ppm of nickel, 16 ppm of sodium and 50 ppm of vanadium yielded fly ash containing large amounts of Ni in the form of oxide and vanadate with an initial fusion point of about 750 C. A vanadate complex of Na, Ca, and magnesium was detected, while sodium metavanadate and sodium vanadylvanadate were not observed. If the initial fusion point of the fly ash is equal with or lower than the operating temperature of the metal surface, a serious corrosion hazard occurs in the presence of one or more corrosive components in the fly ash.

**33745** **APTIC NO. 56562**

Barton, S. C. and H. G. McAdie

AN AUTOMATED INSTRUMENT FOR MONITORING AMBIENT $H_2SO_4$ AEROSOL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C25-C27. 5 refs.*

Refinements in an automated instrument for monitoring ambient sulfuric acid aerosol are outlined. Air is sampled at 15 l/min through a 0.4 micron Nuclepore filter tape for 1 hr, at the end of which the tape advances to the elution stage. Three 1 ml aliquots of 100% isopropanol are dispensed from a constant volume receptacle fed from a reservoir by a peristaltic pump; and suction is applied through a solenoid valve to collect the eluate, whereafter liquid is admitted to a reactor via a solonoid valve. Stirred reaction with a 5 mg/ml slurry of barium chloranilate supplied from a stirred reservoir by a peristaltic pump then takes place for 15 min. The design of the reactor was a significant refinement to the instrument; previously, the base of the reactor cell had been a second Nuclepore filter tape which involved the use of a relatively expensive material and leak-proof O-ring seals. The present design releases the slurry into a simple filtration unit after reaction completion, and a short residence time requires only minimal pressure on the O-ring seal. Minor changes in cell design and connection orientation have also reduced a tendency for bubble formation in the sample cell. A further refinement in methodology relates to the use of a hexamethylenetetramine buffering technique to avoid potential interferences. Only phosphoric acid interferes to any extent with the sulfate determination, and the system response to $H_3PO_4$ is approximately 6% as $H_2SO_4$. Performance data are given for field trials with the prototype instrument.

**33746** **APTIC NO. 56482**

Berglund, Birgitta, Ulf Berglund, and Thomas Lindvall

PERCEPTUAL INTERACTION OF ODORS FROM A PULP MILL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A40-A43. 11 refs.*

The vector model of perceptual odor interaction is presented along with some of its uses in studies of odorous air pollutants. Three laboratory experiments involving mainly odorants present in pulp mill effluents clearly demonstrated that the vector model can predict the odor strength of mixtures from the odor strengths of the basic components once the angle between them (alpha) has been empirically determined. Given the psychophysical function (stimulus-response relation) for each component, the predictions can be made from the odorant concentrations. The same angle (alpha equal to 102 deg) is appropriate for all odorants studied to data. The model may be directly applied for predicting the effects of changes in the composition of odorous effluents from a factory. Data relating to the chemical composition of five pulp mill effluent gases with respect to their reduced sulfur compounds, there absolute odor threshold values, and their matched hydrogen sulfide concentration equivalents, as well as the perceived odor strength were collected in a field study. The concentrations at the same multiple of threshold for the different gases did not result in the same perception of odor intensity; this result strongly opposes the common conception that multiples of thresholds represent reliable grading of perceptions, and makes it necessary to combine threshold determination techniques with reliable scaling methods in environmental control. Application of the vector model on the five effluents required a transform of the physical concentration values into perceptual values for each component separately. There were large discrepancies between the odor strength of the effluents and the odor strengths calculated from the known components, and it is presently impossible to determine if the differences have an origin in process technology.

**33747** **APTIC NO. 56871**

Bilger, R. W.

MEASUREMENT OF OXIDES OF NITROGEN IN MOTOR VEHICLE EXHAUST. *Clean Air (J. Clean Air Soc. Australia New Zealand), 7(3):46-49, Aug. 1973. 30 refs.*

The problems associated with the measurement of nitrogen oxides from gasoline engine exhaust can be broadly divided into: obtaining correct sample; and correctly analyzing the sample. The main methods of sample collection are: the continuous sampling technique, in which a sample is extracted from the exhaust at a continuous and constant flow rate and monitored by rapid response instruments; the constant volume sampline technique, in which the exhaust stream is mixed with prepurified filtered air, the mixture cooled and pumped at a constant volume flow rate, and a small but constant flow rate sample extracted before the pump and accumulated in a plastic bag; and the total bag sampling technique, in which the total undiluted exhaust emission is pumped into a plastic bag after the gases have been cooled in a heat exchanger and the condensate removed. With regard to sample analysis, the ozone-chemiluminescent method is used almost universally by the motor vehicle industry and regulatory authorities for NOx analysis. The method is based on the chemiluminescence of the reaction of ozone with nitric oxide or by the photo-decay of the excited nitrogen dioxide molecule formed. Prior to analysis, a thermal converter is used to convert NO2 in the sample to NO; this conversion is required since only the NO is measured in the chemiluminescent analyzer. There is a need for a standard procedure to be developed for measurement of NOx emissions with the ECE 15 and ADR 27A procedures already in use for measuring carbon monoxide and hydrocarbons. Two feasible approaches to this problem are suggested.

**33748** **APTIC NO. 56615**

Bourbon, P., J. Alary, J. Esclassan, and F. Alengrin

CONTRIBUTION TO THE STUDY OF NITROGEN OXIDES. *(Contribution a l etude des composes NOx). Text in French. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C89-C92. 6 refs.*

The efficiency of the Saltzman colorimetric method for the determination of nitrogen dioxide and nitric oxide in the air was studied in laboratory and field tests, and actual NO2 and NO measurements were performed in different polluted environments. Air was sampled at a rate of 1l/min through an absorber containing Buck-Stratman reagent that absorbed 90-100% of the total NO2, after which it passed through another bubbler in which NO was oxidized into NO2 at a rate of 90-100% on chromium trioxide used as the catalyst for subsequent absorption. While being absorbed in the first bubbler, NO2 generated some 10% NO. The Saltzman gaseous NO2 to ionic NO2 conversion factors, determined for NO2 concentrations below 1 ppm, of up to 200 ppm, and between 300 and 1000 ppm, are 0.75; 0.73, and 0.5. Nitrogen oxides concentrations between 30 and 300 micrograms/cu m, and NO/NO2 ratios between 2 and 5 were determined in urban areas with intense traffic. The NOx concentrations measured in a 3 km radius around a thermal power plant emitting 15 tons of NO daily in a rural area were below 20 micrograms/cu m, and a NO/NO2 ratio between 1 and 2 was obtained. Nitrogen oxide concentrations of 10-100 micrograms/cu m and a NO/NO2 coefficient of 0.5 to 1 were measured near a HNO3 manufacturing plant emitting some 750 kg of NO and NO2 daily from a 35 m-high stack.

**33749** **APTIC NO. 56686**

Brown, J. W., D. W. Pershing, Wasser, and E. E. Berkau

INTERACTIONS OF STACK GAS SULFUR AND NITROGEN OXIDES ON DRY SORBENTS. *Preprint, 20p., Aug. 1973. 4 refs.*

The interactions of stack gas sulfur and nitrogen oxides on dry sorbents were investigated. A three part approach was utilized. Controlled mixtures of ambient air, nitric oxide, and sulfur dioxide were prepared, passed through various types of drying systems, and then sampled to determined exactly what interferences and/or interactions should be expected. The tests were repeated using actual flue gas from a propane flame with and without SO2 present. Finally, the work was extended to full scale testing on a package boiler burning residual oil with 0.9% S. The use of a solid sorbent drying material prior to NO analysis can lead to erroneously measured NO concentrations in SO2-laden flue gases. Drierite and molecular sieves are susceptible to this problem in varying degrees; calcium chloride dehydrate appears to be a possible alternative but needs a more complete analysis. Both Driertie and molecular sieve are capable of simultaneous NO and SO2 removal when both are present even in low concentrations. Experimental work should be undertaken to define the fate of the specie and to develop data on the effect of sorbent composition and structure, NOx and SOx concentrations, and regeneration times so that a reasonable economic analysis can be conducted. (Author conclusions modified)

**33750** **APTIC NO. 56429**

Coles, R. R. and B. J. J. Shak

THE MEASUREMENT OF PARTICULATE IMMISSIONS AND EMISSIONS. *Preprint, British Steel Corp., London (England), Corporate Engineering Lab., 42p., 1973. 29 refs.*

Instruments for the measurement of particulate immissions and emissions are surveyed with particular reference to the automatic and continuous measurement of stack emissions. The report discusses current development, reviews the principles of operation involved with specific comments on application and suitability, gives references of published assessment where available, and furnishes details or representative instruments commercially available. Names and addresses of United Kingdom suppliers or details of overseas manufacturers are given. The instrumentation includes: deposit gauges, precipitators, fabric filters, sampling probes, smoke density meters, flue dust monitors,and remote sensors.

**33751** **APTIC NO. 56811**

Dewey, C. F., Jr., R. D. Kamm, and C. E. Hackett

ACOUSTIC AMPLIFIER FOR DETECTION OF ATMOSPHERIC POLLUTANTS. *Appl. Phys. Letters, 23(11):633-635, Dec. 1, 1973. 16 refs.*

The feasibility of detecting atmospheric pollutants using acoustic signals produced by the volumetric absorption of infrared radiation has previously been demonstrated. A substantial improvement in this technique was investigated. With the improved technique, the optical excitation beam is modulated at a frequency corresponding to a natural acoustic resonance of the sample chamber. Acoustic amplification factors exceeding 100 have been observed. The resonant optoacoustic system described herein appears to offer substantial advantages over previous nonresonant methods and seems to be promising as a basis for the development of improved instruments for trace gas analysis. (Author abstract modified)

**33752** **APTIC NO. 56849**

Ecknig, W., W. Beulich, and U. Plewka

QUALITATIVE ANALYSIS OF THE NEUTRAL FRACTION FROM THE OFF-GASES OF A BERLIN INDUSTRIAL COMPLEX BY COMBINATION OF TEMPERATURE- PROGRAMMED GAS-CHROMATOGRAPHY AND UV-SPECTROSCOPY. *(Qualitative Analyse der Neutralfraktion aus den Abgasen einer Berliner Industrieanlage durch Kombination von temperaturprogrammierter Gas-Chromatographie und UV-Spektroskopie). Text in German. Z. Ges. Hyg. Ihre Grenzgebiete (Berlin), 19(10):712-719, 1973. 53 refs.*

The qualitative analysis of polycyclic aromatics in the waste gases developing through distillation, thermal decomposition, and chemical reactions of tar and pitch components at the manufacture of carbon brushes for electric motors is discussed. The gas is drawn at a rate of 100 l/hr through two successive scrubbers filled with 5% sodium lye and 5% sulfuric acid for binding the acid and alkaline components. The neutral fraction in the gas passes the two scrubbers and is collected on a filter. For efficient collection, the filter temperature is not to exceed 18 C. For recovery of the neutral fraction from the filter, it is extracted for a period of 10 hr with cyclohexane. About 10 ml of the obtained cyclohexane solution is carefully evaporated in an air flow at room temperature. The polycyclic aromatics settle on porolite which has been dehactivated with 5 mg dimethyl silizane. A solid substance is obtained which can be easily applied to the chromatographic column through the open inlet which is then sealed with a teflon disk. The gas chromatogram is taken from 50 to 300 C with a temperature increase rate of 1.7 deg/min. Through additional ultraviolet spectroscopy about 90% of the organic material could be identified.

**33753 APTIC NO. 56748**

Ettinger, Harry J., Charles I. Fairchild, Lawrence W. Ortiz, and Marvin I. Tillery

AEROSOL RESEARCH AND DEVELOPMENT RELATED TO HEALTH HAZARD ANALYSIS. JANUARY 1 THROUGH JUNE 30, 1973. (PROGRESS REPORT). *Los Alamos Scientific Lab., Los Alamos, N. Mex., Industrial Hygiene Group, Atomic Energy Commission Contract W-7405-Eng. 36, National Institute for Occupational Safety and Health Proj. R 072, 30p., July 1973. 8 refs.*

NTIS: LA-5359-PR

A reproducible fibrous glass aerosol was developed and used to relate gross and respirable fiber mass to fiber count. Experimental data indicate a fiber mass count relationship and reproducible 10 mm nylon cyclone aerodynamic cutoff characteristics, suggesting the practicality of using this instrument as a respirable sampler for fibers. New techniques were developed for preparing permanent asbestos filter mounts for phase contrast in microscopy and transferring particulates and fibers from membrane filters to electron microscope grids. Membrane filter samples containing chrysotile asbestos were analyzed using optical and electron microscopy. Electron microscopy indicates more than three times as many fibers greater than 5 micron, as compared with optical microscopy. When also considering small fibers, the electron microscope indicates over 20 times as many fibers compared to optical microscope analysis. A large aerosol test system was constructed with a design flow rate of 100 cfm. Development of a standard coat dust is completed. Experimental data confirm that high humidity conditions alone will not change the aerodynamic size characteristics of a nonhygroscopic aerosol. Experimental data and theoretical calculations provide a basis for quantitating the combined effects of temperature and humdity changes on aerodynamic size. A theoretical model was developed indicating how the differing effect of high humidity on fibrous and nonfibrous materials could be used to fractionate these materials during air sampling. (Author abstract modified)

**33754 APTIC NO. 56845**

Forweg, Walter and Hans-Joachim Crecelius

SEPARATION OF AQUEOUS AEROSOLS WITH LOW CONTENTS OF INORGANIC CONDENSATION NUCLEI ESPECIALLY HYDROCHLORIC ACID, DURING SAMPLING FOR CONCENTRATION MEASUREMENT. *(Die Abscheidung waessriger Aerosole mit niedrigen Gehalten anorganischer Keimbildner, insbesondere Chlorwasserstoff, bei der Probenahme fuer Immissionsmessungen). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C21-C24. 3 refs.*

Experiments concerning the determination of the particle size distribution and the rate of separation by different types of analytical samplers of aqueous aerosols containing hydrochloric acid as condensation nuclei are described. The particle size distribution was determined by short-time microholography, using a giant-pulse ruby laser. A comparative study of the aerosol separation efficiencies of membrane filters, glass-fiber filters, synthetic fiber filters, silica gels, silver wool, and adsorption tubes filled with silver balls, wetted and non-wetted glass balls, Raschig rings, and of dry fritted glass revealed that membrane filters with pores smaller than 3 micron, glass-fiber filters, and dry fritted glass have efficiencies of over 99% for all size ranges from 0.3 to over 5 micron at flow rates of 50-180 l/hr. Membrane filters with 12 micron-pores, silica gel, and adsorption tubes filled with Raschig rings and glass beads were found unsatisfactory. Shifts in the particle size distribution during passage through membrane filters, fritted glass, and silica gel toward lower particle size maxima, possibly due to the crushing of larger aerosol particles, was observed.

**33755 APTIC NO. 56504**

Fujisawa, Hinoki

ANALYTICAL AND MEASURING INSTRUMENTS FOR SULFUR DIOXIDE. *(Aryusan gasu bunseki, sokutei kiki). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(1):55-62, Jan. 1973. 4 refs.*

Sulfur dioxide can be measured by iodimetry, detection tubes, conductivity, and infrared gas analysis. These methods are described. The detection tube method is faster and simpler than iodimetry. Infrared spectrometry and solution conductivity are usually used for continuous analysis, the latter is the most widely used method for determination of SO2 in air.

**33756 APTIC NO. 56724**

Goulding, Fred S. and Joseph M. Jaklevic

X-RAY FLUORESCENCE SPECTROMETER FOR AIRBORNE PARTICULATE MONITORING. (FINAL REPORT). *Calif. Univ., Berkeley, Lawrence Radiation Lab., Environmental Protection Agency Contract EPA-IAG-0089(D)/A, Program Element No. 1A1003, EPA-R2-73-182, 70p., April 1973.*

NTIS: PB 225038/9AS

An automated system for determining the elemental composition of ambient air has been developed. Airborne particulate matter is collected on up to 36 membrane filters which are sequentially introduced into the sample stream. The duration for the collection period can be adjusted to range from one to 24 hr. The elemental composition of the collected particulate matter is determined in the analysis station using an energy-dispersive x-ray spectrometer. Each filter is separately analyzed using each of three secondary fluorescers in order to optimize the sensitivity for a wide range of elements which have atomic numbers greater than 12. The results for each filter are printed out on a teletypewriter and written on magnetic tape. A maximum of 36 filters can be accommodated without operator attention. (Author abstract modified)

**33757 APTIC NO. 56623**

Gravatt, C. C. and Ivo Allegrini

A NEW LIGHT SCATTERING METHOD FOR THE DETERMINATION OF THE SIZE DISTRIBUTION OF PARTICULATE MATTER IN AIR. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C3-C5. 3 refs.*

A new light scattering method based on particle sizing by the forward lobe ratio method is presented for the determination of the size distribution of particulate matter in air. An angular ratio of 20 deg/10 deg is effective over the particle range 0.1-1.5 micron, a ratio of 10/5 over the range 0.2-4 micron, and a ratio of 5/2.5 over the range 0.5-10 micron. Inherent error in the particle size, due to index of refraction variation in the sample, is no greater than plus or minus 15%. The effect of angular aperture was small, and moderate apertures of approximately 0.5 deg were advantageous in that they increase the scattered intensity and do not degrade the size sensitivity. An experimental study of the forward lobe method was conducted with an instrument which employs the ratio of 10 deg/5 deg and an aperture of 0.25, uses a 50 mW argon ion laser as source, and an annular iris fiber optic system as the light collector. The scattered light is detected by two photomultipliers, and the scattered intensity at each angle is integrated in analog circuits. Pulses are counted in a multichannel analyzer to determine the particle size distribution. Total size error including theoretical and experimental factors is estimated at no greater than plus or minus 20%. Particles in the diameter range 0.05-0.2 micron which are below the resolution of the ratio method, although they can be detected by the system, can be sized by a single forward lobe intensity or by a difference of two forward lobe intensities. The error of these techniques is approximately plus or minus 25%. One possible way of eliminating the majority of the experimental errors is to normalize the intensity data by the time of flight of the particle through the laser beam. The method also appears feasible for characterizing particles larger than 0.3 micron diameter as carbon-like, metal-like, or nonabsorbing.

**33758 APTIC NO. 56481**

Grennfelt, Peringe and Thomas Lindvall

SENSORY AND PHYSICAL-CHEMICAL STUDIES OF PULP MILL ODORS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A36-A39. 6 refs.*

The applications of sensory and physical-chemical methods in monitoring odorous effluents from a pulp mill at the source and in the field were examined. A series of comparative experiments were conducted around a pulp mill in order to investigate the applicability of the sulfur-sensitive flame photometer for field studies and to outline the odor profile of the plume using human observers and a tracer gas (sulfur hexafluoride). Outdoor observations of ambient sulfate odors were made by 25-28 observers placed on a line perpendicular to the plume at 50-100 m intervals, and SF6 was fed into the stack of the washery. Odor profiles and SF6 concentrations were very irregular, and the reported odor strength was not always congruent with the SF6 concentration. The irregular patterns agreed very well with the common opinion that odor concentration may differ considerably in areas exposed to pulp mill odors; it may also have been that mixing of odorous effluents from the mill was incomplete at 1-3 km and that the SF6 profiles simply represented the spread of the washery effluents. Experiments to determine to what extent observations of pulp mill odors in the ambient air correspond to measurable quantities of sulfur compounds for longer periods of time and in natural conditions revealed that the actual incidence of odor coincides to a strikingly high degree with the observations of reduced sulfur compounds. There were, however, large discrepancies in observed time length. Results are also given for source analyses at various sampling points throughout the plant.

**33759 APTIC NO. 56846**

Grimmer, Gernot, Armin Hildebrandt, and Heinz Boehnke

INVESTIGATIONS ON THE CARCINOGENIC BURDEN BY AIR POLLUTION IN MAN. III. SAMPLING AND ANALYTICS OF POLYCYCLIC AROMATIC HYDROCARBONS IN AUTOMOBILE EXHAUST GAS. 2. ENRICHMENT OF THE PNA AND SEPARATION OF THE MIXTURE OF ALL PNA. *Zentralbl. Bakteriol., Parasitenk. Infektionskr. Hyg.:Abt. 1:Orig, Reihe B, 158(1):35-49, 1973. 1 ref.*

For the recovery of the polycyclic aromatic hydrocarbons from the sampler for automobile exhausts, the glass cooler is rinsed with acetone. For extraction of the glass fiber filter, dimethyl formamide is used. For enrichment of the polycyclic aromatic hydrocarbons, a multi-step process is described. Part of the acetone solution is diluated with water and extracted with cyclohexane. The cyclohexane phase is mixed with a solution of 100.0 micrograms 3,6-diemthylphenanthrene and 8.0 micrograms benzo(b)chrysene and extracted with dimethylformamide-water (mixing ratio 9:1). The separated dimethylformamide phase is diluted with water and extracted with double the amount of cyclohexane. The cyclohexane phase which has been washed with very little water is reduced to 1 ml and filtered in a silica gel column. The dyr matter of the filtrate dissolved in isopropanole is separated into two fractions (aromatics with 2 to 4 rings and 4 to 7 rings). Both fractions are prepared for gas chromatography. The reproducibility of the driving program and of the method of determination was checked by comparison of four European tests of a vehicle.

**33760 APTIC NO. 56609**

Grupinski, Leonhard

APPLICATION OF IR SPECTROMETRY FOR EMISSION MEASUREMENTS. *(Anwendung der Infrarotspektrometrie bei Emissionsmessungen). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C45-C46. 2 refs.*

Sampling and IR spectrometric techniques for the determination of organic vapors, such as of cresol, dioctylphthalate, PVC, dimethylformamide in the air, for the evaluation of the efficiency of exhaust equipment is described. Air samples can be taken through non-heated probes usually at a flow rate of 1 l/min. Isokinetic sampling is not necessary. The organic vapors are then absorbed by perchloroethylene, and the sample is analyzed for concentration determination aginst a standard in infrasil cuvettes of 1 to 4 cm thickness and of 1 cm breadth in an infrared range of 2500, to 4000/cm. Analysis is possible in a range of 1600 to 4000/cm by the use of sodium chloride or potassium bromide windows.

**33761 APTIC NO. 56549**

Harbourn, C. L. A., W. H. McCambley, and T. J. Trollope

THE MEASUREMENT OF TRACES OF ETHYLENE IN THE ATMOSPHERE. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C38-C41. 11 refs.*

A method for the analysis of trace quantities of ethylene in the atmosphere with a concentration detection limit of 0.002 ppm is described. A trap is directly coupled to a gas chromatograph gas sampling valve in place of the conventional open tube sample loop. The sample is drawn through the trap at a flow rate of 100 ml/min for 10 min, and the total volume passed (1l) is measured on a wet gas meter situated after a pump used for taking the samples. The trap is packed with activated 13X molecular sieve and is conditioned before use by heating at 300 C for 2 hr with a carrier gas flow rate of 50 ml/min. The chromatograph should be prepared for use in the normal manner and set to operate at 70 C for Porapak Q and 50 C for Spherosil. It should be fitted with a flame ionization detector with a sensitivity of ca 0.001 coulombs/g of carbon at a noise level of less than 1 times 10 to the minus 13 amp. The chromatogram is developed and measured in the normal way, the ethylene concentration being calculated by reference to a calibration graph or an equation obtained from the results on synthetic blends. Typical ethylene concentrations are given for measurements made in the Swansea area of South Wales.

**33762 APTIC NO. 56443**

Hayakawa, M.

QUANTITATIVE GAS ANALYSIS BY MASS SPECTROMETER (NO. 3)-- QUANTITATIVE ANALYSIS OF CARBON MONOXIDE AND NITROGEN. *Kogyo Kagaku Zasshi (J. Chem. Soc. Japan), vol. 74:752-754, 1973. 8 refs. Translated from Japanese by SCITRAN, National Aeronautics and Space Administration, 9p., June 1972. (NASA TT F-14,322) (Presented at the Nippon Bunseki Kagakuhai Meeting, 1st, Oct. 1954.)*

NTIS: N72-26102

The problem of separating compounds with similar M/e using a mass spectrometer is discussed. One possible solution is to oxidize one of the components by chemical means. A method using copper oxide is described. The method requires carbon monoxide to be completely oxidized by CuO, and that the adsorption of gases on CuO is negligible at 270 C. Although the computation may become complicated, the method is applicable to the quantitative analysis of mixtures which contain hydrocarbons in addition to CO and nitrogen. (Author abstract modified)

**33763** **APTIC NO. 56812**

Henriques, A., J. Isberg, and K. Kjellgren

COLLECTION AND SEPARATION OF METALLIC MERCURY AND ORGANO-MERCURY COMPOUNDS IN AIR. *Chem. Scr., 4(3):139-142, 1973. 34 refs.*

A method for the collection and direct separation of the vapor of metallic mercury and monomethyl and dimethyl mercury was developed on the basis of new observations concerning the adsorption of dimethyl mercury and methylmercuric chloride to gold, both coated and uncoated with a gold-silicon alloy, and concerning the oxidation of dimethyl mercury in an acid permanganate solution. Two examples of simple absorption units are given; they were designed for mercury determination in areas with no direct connection with industry. The required apparatus and reagents are also discussed. (Author abstract modified)

**33764** **APTIC NO. 56804**

Herrick, R. A., S. Kinsman, J. Lodge, D. Lundgren, C. Phillips, W. C. Rutledge, R. S. Sholtes, E. Stein, J. J. Stukel, and J. Wagman

TENTATIVE METHOD OF ANALYSIS FOR ATMOSPHERIC VISIBILITY (INTEGRATING NEPHELOMETER METHOD). *Health Lab. Sci., 10(4):354-356, Oct. 1973. 6 refs.*

The integrating nephelometer method for the analysis of atmospheric visibility is described. The integrating nephelometer determines atmospheric visibility by continuously monitoring the amount of light scattered by the suspended particulates in the atmosphere. The air sample within the viewing volume of the nephelometer is illuminated by a high intensity lamp and the amount of light scattered by the aerosols is measured by a sensitive photon detector. The integrating nephelometer used for measuring atmospheric visibility should be able to measure the scattering coefficient over a visual range of 0.4 to 40 km. A spatially homogeneous aerosol must exist for the measurement to represent the observed visual range. The precision and accuracy of the method are discussed, as the apparatus and reagents required, the analytical procedure, and the standards and calibration procedure.

**33765** **APTIC NO. 56524**

Hollingdale-Smith, Peter A. and Leslie C. Thomas

TOTAL AIR POLLUTION MEASUREMENTS USING A MOBILE LABORATORY. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C126-C129.*

A mobile laboratory for the identification and measurement of all gaseous air pollutants and the sampling of particulate pollutants is described. The laboratory consists of an infrared spectrophotometer fitted with a matched pair of long path multireflection gas cells, gas chromatographic equipment, a quadrupole mass spectrometer, particulate sampling equipment, and equipment for measuring and recording wind directions and velocities. Air is drawn into the van at roof level through a vertical glass duct by a fan mounted below the floor; and samples can be taken into the infrared gas cells, the mass spectrometer, and through adsorbents for subsequent gas chromatographic analysis. Infrared spectrophotometry was chosen as the initial method for the examination of polluted atmospheres because of its versatility in revealing the presence of any gaseous compound present at a high enough concentration, whether expected or not. The other two methods of analysis extend the sensitivity of detection to lower levels. Results are normally plotted as a function of time, wind speed, and wind direction. Some examples are given of data collected.

**33766** **APTIC NO. 56759**

Jaklevic, Joseph M., Fred S. Goulding, Blair V. Jarrett, and John D. Meng

APPLICATION OF X-RAY FLUORESCENCE TECHNIQUES TO MEASURE ELEMENTAL COMPOSITION OF PARTICLES IN THE ATMOSPHERE. *California Univ., Berkeley, Calif., Lawrence Berkeley Lab., Atomic Energy Commission Contract W-7405-Eng-48, Environmental Protection Agency Contract EPA-IAG-0089 (D)/A, Rept. LBL-1743, 35p., July 1973. 12 refs. (Presented at the American Society Meeting on Analytical Methods Applied to Air Pollution Measurements, 165th, Dallas, Tex., April 8-13, 1973.)*

The design and operation of a system for the automated x-ray fluorescence analysis of atmospheric particulates on filters is described. Central to the system is a low background silicon (lithium) semiconductor detector coupled to a low power variable energy x-ray tube used to generate monoenergetic photons for fluorescence excitation. Sequencing of the filter analysis, changes in x-ray excitation energy and intensity, together with data storage can be performed without operator intervention under the control of a small dedicated computer. Reduction of pulse height data and intensity calibration can be performed in real time in this same computer. The three analyses required to cover over 30 elements can be performed in a total time of 1/2 hr with detection limits in the worst case of 25 ng/sq cm or less over filter areas of 7 sq cm. A single analysis for a restricted group of 15 elements at a detection level below 10 ng/sq cm can be performed in 10 min. Samples are generated using a fully automated remote sampling station designed for the unattended collection of up to 30 filter samples using a variety of commercially available filtering materials. The accuracy and sensitivity of the method compared to other sampling and analysis techniques is discussed. (Author abstract modified)

**33767** **APTIC NO. 56813**

Kaminski, H.

REMOTE SENSING OF AIR AND WATER POLLUTION. *Underwater J. Inform. Bull., 5(5):221-227, Oct. 1973. 8 refs.*

The possibilities of using infrared satellite photography for studies of thermal pollution are discussed. Unmanned satellites which circle the earth at heights of 800 to 1500 km and operate in the 3.4 to 4.2 micron range provided possibilities for continuously observing various processes in all regions. Data obtained from a study of infrared imagery using NIMBUS, NOAA, and ITOS weather satellites are reported. The pollution of coastal waters and the air over industrial areas in Europe has already reached a dangerous level, and pollution is of two major types (chemical and thermal) which interact with each other so that the effects are exponential. The result is short and long-term poisoning of animal and plant life on an interactive basis, and the theory that there is a safe limit to environmental pollution is false. Geo-scientific studies should make use of satellites operating at all spectral wave-length ranges, as each range has its own particular value and uses.

**33768** **APTIC NO. 56901**

Katerle, Hans-Joachim

LIDAR MEASUREMENTS FOR POLLUTION STUDIES. *(Lidar-Messungen zur Erforschung der Atmosphaere). Text in German. Laser, 5(4):43-45, Aug. 1973. 10 refs.*

Problems and possibilities of lidar measurements for air pollution studies in general, and for the determination of the vertical structure of the atmosphere and of aerosol layers in particular, are discussed. Solid-state lasers, such as ruby lasers, emitting giant pulses in Q switch operation mode at a pulse rate of 1 to 60/min are used for atmospheric probings. Lidar systems use mostly Cassegrain mirrors as receivers with narrow-band interference filters. Multistage multipliers with S2O trialkali photocathode are used as photoelectric receivers. In evaluating lidar measurements, a lidar profile, calculated for an atmosphere composed purely of molecules, is compared with the measured profile which incorporates the influences of both molecules and aerosols. Digital data acquisition for lidar systems is possible by means of analog-digital converters, or of a multi-track analog magnetic tape. Actual lidar measurements done by instrumented aircraft detected an aerosol layer at a 17 to 20 km altitude. Aerosols were tentatively detected in the 30 to 50 km layer of the atmosphere by lidar measurements.

**33769** **APTIC NO. 56865**

Kenneweg, Hartmut

THE PROBLEM OF RECOGNIZING AND DEMARCATING FUME DAMAGE ON AERIAL PHOTOS. *(Zur Frage der erkennung und abgrenzung von Rauchschaden aus Luftbildern). Text in German. Mitt. Forst Bundesvers., no. 97:295-305, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

Aerial photographic investigations of sulfur dioxide and hydrogen fluoride polluted forests in Germany indicate that color photos were more easily interpreted than black and white photos, and that false color photos were usually better than normal color photos. Damage symptoms invisible in the field remained invisible on the photos as well, and systematic morphological structure intensified the effects of damage such as foliage discoloration or defoliation, while variable habit makes interpretation more difficult. The basic element in the interpretation of forest damage is the individual tree crown, the size of which determines the photo scale. Photo quality, tree species, picture scale, and type and concentration of pollutant make it possible to rank individual crowns into three to five damage classes, although direct determination of the cause of damage is seldom possible. Particularly favorable conditions for photography make it possible to distinguish between old and fresh damage on Ektrachrome Infrared film. With regard to the spruce stands under investigation, there was a relative increase in damage towards the center of the pollution zone, and younger stands generally exhibited less damage than older stands. No demonstrable influence of slope direction was found on the degree of damage, although damage increases with increasing altitude. Pinus strobus stands exhibited the worst damage and fewer differences due to terrain.

**33770** **APTIC NO. 56866**

Kneip, T. J., R. S. Ajemian, J. R. Carlberg, J. Driscoll, L. Kornreich, J. W. Loveland, J. L. Moyers, and R. J. Thompson

TENTATIVE METHOD OF ANALYSIS FOR CHROMIUM CONTENT OF ATMOSPHERIC PARTICULATE MATTER BY ATOMIC ABSORPTION SPECTROSCOPY. *Health Lab. Sci., 10(4):357-361, Oct. 1973. 5 refs.*

An atomic absorption spectroscopic method is presented as a tentative method for the analysis of the chromium content of atmospheric particulate matter. Samples are collected by drawing a known volume of air through membrane or glass fiber filters, after which the samples are ashed and extracted with a mixture of nitric and hydrochloric acids. The analysis is subsequently made by atomic absorption spectroscopy using the 357.9 nm Cr line. An atmospheric concentration of 0.005 micrograms of Cr/cu m can be detected using the method as described. Excessive amounts of iron and nickel can interfere with the results, as can silica extracted from the glass fiber filter and from the collected particulate matter. The precision of the method has not been reported using air samples, although a relative standard deviation of 22% was obtained for urban concentrations using a nearly identical method; the recovery by this method is 88% provided the matrix of the sample is not appreciably different from that of the standards. The apparatus and reagents required are discussed, as are the sampling and analytical procedures, the standard Cr solution and blank, the calculation procedure, and the effects of storage.

**33771** **APTIC NO. 56765**

Krelli, L., G. Eyer, K. Amudryu, G. Gibbs, S. Kholms, E. Okchella, and R. dyu Tua

EVALUATION OF THE EFFECT OF ASBESTOS IN INDUSTRIAL ENVIRONMENT. *(Otsenka vozdeystviya asbesta v usloviyakh proizvodstvennoy sredy). Text in Russian. Gigiena i Sanit., no. 2:76-79, 1973. 4 refs.*

Recommendations of the Asbestosis Subcommittee of the Standing Committee and of the International Association of Occupational Diseases concerning the sampling and analysis of asbestos in industrial environment for the assessment of its action on the human organism are presented. Asbestos dust should be sampled by means of membrane filters in the respiration zone. Respirable asbestos fibers smaller than 5 micron, and with a minimum length to-diameter ratio of 1:3 are counted by light microscopic method for the assessment of the degree of exposure. The considerable differences in the biological action of different types and varieties of asbestos requires identification of the type of the asbestos fibers counted. The samples should be also analyzed for possible traces of metals, free silica, and organic impurities, such as polycyclic aromatic hydrocarbons.

**33772** **APTIC NO. 56577**

Kuroda, Daisuke

DETERMINATION OF NITROGEN OXIDES BY THERMO-DETECTION LIQUID CHROMATOGRAPHY. (STUDY ON ANALYTICAL METHOD OF NITROGEN OXIDES, V.). *(Netsu kenshutsugata ekitai kuromatogurafu ni yoru chisso sankabutsu no teiryo). Text in Japanese. Bunseki Kagaku (Japan Analyst)(Tokyo), 22(9):1186-1190, Sept. 1973. 5 refs.*

Thermo-detection liquid chromatography and a grab sampling method were used to determine the concentrations of various oxides of nitrogen in combustion gas. Nitrogen monoxide was converted into nitrogen dioxide or nitrogen sesquioxide, after which these oxides were absorbed in an oxidizing aqueous solution to form nitrate ions. The sample gas is transferred into an evacuated gas sampling flask containing the absorbent, the oxygen and air are mixed in, and the flask allowed to stand for 2 hours. After the NOx are completely absorbed, the contents of the flask, along with a small amount of water, are transferred to a volumetric flask into which 1 ml of 1 N sodium sulfite solution is added. The NO3 are concentrated using a condensation column and their concentration is determined using liquid chromatography. Using this method, the average concentration of NOx in a stack gas sample was found to be 125 ppm, with a coefficient of variation of 4.0%. This method is as precise as the more commonly employed phenoldisulfonic acid method and lends itself to the rapid analysis of NOx in combustion gas. Coexisting ions such as carbonate, sulfite, sulfate, and nitrite do not interfere with the determination of the NO3 concentration.

**33773** **APTIC NO. 56941**

Kutsenogiy, K. P. and B. M. Gol dman

THE USE OF THE KOL-90 MODEL NEPHELOMETER AS AN OPTIC SENSOR FOR A PHOTOELECTRIC AEROSOL PARTICLE COUNTER. *(Ispol zovaniye nefelometra KOL-90 v kachestve opticheskogo datchika fotoelektricheskogo schetchika aerozol nykh chastits). Text in Russian. Zavodsk. Lab. (Moscow), 39(8):1031-1032, 1973.*

The use of the KOL-90 model nephelometer as an optic sensor for a photoelectric aerosol particle counter for low aerosol particle concentrations is described. The Lumiere s cube was removed from the nephelometer to reduce the light scattering by the aerosol particles, and the nephelometer was attached to a photomultiplier. Comparative aerosol particle countings revealed systematically increased particle counts for the nephelometer in association with the photoelectric attachment relative to ultramicroscopic counting. This difference is probably due to the sharp decrease in the sensitivity of the photoelectron multiplier as a result of using the first diaphragm of the ultramicroscope. The nephelometer is suitable for aerosol particle counting starting from a particle concentration as low as unit per liter.

**33774** **APTIC NO. 56915**

Leichnitz, Kurt

DETERMINATION OF COMBUSTION GAS COMPONENTS, ESPECIALLY OF SO2, IN THE AMBIENT AIR. *(Bestimmung der Abgasbestandteile von Feuerungsanlagen - speziell SO2 - in der Umgebungsluft). Text in German. Oel Gas, no. 9:32-38, 1973. 6 refs.*

Draeger tubes for the determination of small concentrations of sulfur dioxide, carbon monoxide, nitric oxide plus nitrogen dioxide, and ozone in the ambient air are described. Each Draeger tube has a standard measuring range that can be substantially lowered toward lower concentrations by the increase of the air sample volume, i.e., by increasing the number of the sampling pump strokes. The test tube 0.1/a, designed for the detection of SO2 in a concentration range of 0.1-3 ppm by a methyl red indicator at a stroke number of 200, has a measuring range of 0.02-0.6 ppm at a stroke number of 500. The test tube 5/c, designed for CO detection, has a standard measuring range of 5-150 ppm at a stroke number of 10, and a lower measuring range of 0.5-15 ppm at a stroke number of 100. The nitrogen oxide test tube model 0.5/a has a standard measuring range of 0.5-10 ppm at a stroke number of 5, and a lower limit of detection of 0.01 ppm at a stroke number of 200. The ozone test tube model 0.05/a is suitable for ozone concentration measurements in the standard range of 0.05-1.4 ppm, and in another range of 0.005-0.14 ppm at strokes numbers of 10 and 100, respectively.

**33775** **APTIC NO. 56572**

Luiga, Peeter

A SYSTEM OF CUMULATIVE DETERMINATION OF AIR POLLUTANTS IN AREA SURVEYS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C130-C132. 10 refs.*

A system for the cumulative determination of air pollutants in area surveys is described. The purpose of the system is to obtain only average and relative data about the pollutants from a great number of sampling sites within a grid. Distances between sampling sites is about 1 km, and the number of sampling sites can reach a hundred or more. Corrections are made after the initial period of measurements by installing additional cumulative test devices in locations with a high gradient of contaminant concentration and removing some devices from places of uniform pollution level. Sulfur dioxide measurements are made by the corrosion-weight loss method which compares favorably with the use of potassium carbonate impregnated filter papers. The same papers can be used for determination of nitrogen dioxide and fluorides. Carbon monoxide is measured with 1% lead chloride impregnated filter paper strips. Accumulation of organic contaminants is performed by gas chromatography column packing materials.

**33776** **APTIC NO. 56790**

Lundgren, Dale A. and Harold J. Paulus

THE MASS DISTRIBUTION OF LARGE ATMOSPHERIC PARTICLES - AND HOW IT RELATES TO WHAT A HIGH-VOLUME SAMPLER COLLECTS. *Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 23p., 1973. 5 refs. (Presented at the Air Pollution Control Association Annual Meeting 66th, Chicago, Ill., June 24-28, 1973, Paper 73-163.)*

Determinations were made of the total mass and mass distribution of atmospheric aerosols, especially those with particles greater than 10 micron in diameter, the fraction of total aerosol mass collected by a standard high-volume air sampler, and the size interval settled out on a dust fall plate. A special aerosol sampling system was designed to obtain representative samples of large airborne particles, and a suburban sampling site was selected because no strong local point sources of aerosols existed nearby. Measurements indicated that atmospheric particulate matter has a bimodal mass distribution; mass associated with large particles mainly ranged from 5-100 micron, while that associated with small particles ranged from an estimated 0.03-5 micron in size. These two distributions produced a bimodal mass distribution with a minimum around 5 micron diameter. The high volume air sampler was found to collect most of the total aerosol mass, while dust fall plates did not provide a very useful measure of total aerosol mass. Condensation and dispersion appeared to account for the formation of the bimodal mass distribution in both natural and anthropogenic aerosols. Particle size distribution measurements were found frequently in error as a result of unrepresentative samples of large airborne particles. Hence, air pollution regulations should specify or be based upon an upper particle size limit. (Author abstract modified)

**33777** **APTIC NO. 56548**

McCormick, M. Patrick and William H. Fuller, Jr.

LASER RADAR MEASUREMENTS OF AIR POLLUTION. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C68-C72. 3 refs.*

Examples of laser radar (lidar) measurements of air pollution are presented which demonstrate the methods capability of determining the top of a mixing layer, the spatial distribution of aerosols within a mixing layer, and the transmissivity and extinction coefficient in such a layer. The actual mixing height determined by lidar is defined as the average altitude during which a strong reduction in scattering ratio or aerosol concentration is observed. Laser radars are most sensitive to aerosols greater than approximately 0.1 micron. Data taken by lidar and nuclei counter concurrently are presented which show that top of the mixing layer as determined by nuclei count lies within the band of decreasing laser radar data; the tops of the mixing layer as determined by these two methods were within 50 m of each other (average difference 22 m) in five cases. A schematic diagram of a 48 in. laser radar system is provided along with illustrations of range corrected laser radar return, range-height- intensity digital presentation of a cloud, and lidar determined meteorological range versus ground visibility as a function of time.

**33778** **APTIC NO. 56838**

Nagarajan, T. M. and K. R. Murrin

THE SIMPLIFIED HALDANE APPARATUS: THE ESTIMATION OF CARBON DIOXIDE CONCENTRATION IN THE PRESENCE OF NITROUS OXIDE. *Anaesthesia, vol. 28:662-665, 1973. 4 refs.*

There are two main sources of error when the Campbell modification of the Haldane apparatus is employed for the measurement of carbon dioxide concentrations in gas mixtures containing nitrous oxide. One is the physical solution of N2O in potassium hydroxide, which is the usual absorption agent. The use of saturated sodium hydroxide, despite certain technical difficulties, is the most reliable method of overcoming this problem. The other source of error is the loss of N2O by diffusion through flexible connections in the apparatus. The elimination of this source of error results in accurate estimations of carbon dioxide concentrations. (Author summary)

**33779** **APTIC NO. 56552**

Oshima, Tsugukage and Shigeyuki Akiyama

ANALYTICAL INSTRUMENT FOR CO IN THE AIR AND GENERAL EXHAUST GAS. *(Ippan haigasu oyobi taikichu no issankatanso bunseki sochi). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(1):63-68, Jan. 1973. 5 refs.*

Carbon monoxide can be separated from air samples by the mercury oxide method or the gas chromatographic method. The CO is then converted to methane and detected by flame ionization gas chromatography. Infrared spectrometry is used for continuous determinations. Dust in the exhaust gas is filtered, and the sample gas whose moisture has been removed by cooling is sent through a second filter and a flowmeter into an analyzer. The correction of the zero and span is carried out at 3 to 7 day intervals and at 7 to 14 day intervals, respectively. For the zero check, clean air is used, and for the span check, the standard gas having a concentration of more than 80% of the total measuring concentration is used.

**33780** **APTIC NO. 56893**

Pinnick, R. G. and D. J. Hofmann

**EFFICIENCY OF LIGHT-SCATTERING AEROSOL PARTICLE COUNTERS.** *Appl. Opt., 12(11):2593-2597, Nov. 1973. 8 refs.*

The counting efficiency as a function of particle size was calculated for a particular forward scattering aerosol particle counter that uses white light illumination for spherical particles with indexes of refraction of 1.33-0 i, 1.40-0 i, 1.50-0 i, 1.592-0 i, 1.50-0.05 i, 1.50-0.5 i, and 1.95-0.66 i. The counting efficiency differs from 100% because of statistical effects: photoelectron statistical broadening, variation in aerosol speed through the illuminated volume, nonuniform illumination of the sampled aerosol, and nonuniformity of the photomultiplier tube photo cathode surface. These spectra broadening effects were determined for the particle counter by measurement of monodisperse aerosols, and the efficiency calculation was based on these measurements. For the particle counter studied, the efficiencies varied from 70% to slightly over 100% in the size ranges where the counter response was single valued. The efficiency for materials for which the response was not single-valued fluctuated wildly in those size ranges from about 20% to more than 10,000%. The efficiency as a function of particle size discriminator level setting was sensitive to particle refractive index and to the aerosol size distribution locally about that particle size. The method for calculating the efficiency can be applied to light-scattering aerosol counters available commercially. (Author abstract)

**33781** **APTIC NO. 56856**

Ross, William D.

**CONFIDENCE LIMITS OF PARTICLE SIZE DISTRIBUTIONS FROM MICROGRAPHS.** *Filtration Separation (Purley), 10(5):587-589, Sept./Oct. 1973. 5 refs. (Presented at the American Institute of Chemical Engineers and the Filtration Society, Joint Symposium, Minneapolis, Minn., Aug. 27-30, 1972.)*

Distributions of particle size which are obtained by microscopically measuring a few hundred particles contain errors caused by the randomness of selecting the particles out of a very much larger lot. A scheme is developed for computing the 95% confidence belts of the distributions by number and by weight. In addition, formulae for the confidence limits of the means, standard deviations, skewness, and kurtosis are included. (Author summary)

**33782** **APTIC NO. 56439**

Schuetzle, D., D. R. Cronn, A. L. Crittenden, and R. J. Charlson

**MOLECULAR COMPOSITION OF SECONDARY AEROSOL AND ITS ORIGIN.** *Preprint, American Chemical Society, Washington, D. C., 32p., 1973. 11 refs. (Presented at the American Chemical Society, National Meeting, 172nd, Symposium on Surface and Colloid Chemistry in Air Pollution Control, Aug. 27, 1973.)*

Several aerosol samples were collected during a diurnal period of inversion and aerosol production in Pasadena, Calif. Particles of diameters less than 1-2 micron and particles of diameters greater than 1-2 micron were collected. Computer controlled mass spectrometric analysis was used for molecular organic and inorganic analysis while x-ray fluorescence and atomic absorption were used to obtain inorganic elemental composition. The diurnal variation in aerosol composition was studied for these two size ranges and used to postulate the primary and secondary origins of the aerosol. The primary pollutants included alkyl benzenes, alkanes, polycyclic aromatics, phenols, and several elements. Secondary pollutants included organic acids, aldehydes, alcohols, chlorides, and nitrates, plus inorganic sulfates, nitrates, and chlorides. Results are discussed with respect to meteorological conditions. (Author abstract modified)

**33783** **APTIC NO. 56566**

Selle, S. J. and G. H. Gronhovd

**SOME COMPARISONS OF SIMULTANEOUS STACK GAS PARTICULATE DETERMINATIONS USING THE ASME AND EPA METHODS.** *J. Eng. Power, 95(3):145-149, July 1973. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting, New York, Nov. 26-30, 1972, Paper 72-WA/APC-4.)*

Simultaneous determinations of particulate concentrations were made by the methods of the American Society of Mechanical Engineers and the Environmental Protection Agency on flue gas from a test furnace burning about 75 lb/hr of low-sulfur North Dakota lignite. Comparisons were made at dust and fly ash concentration levels of about 0.5 and 0.01 grain per standard cu ft. The two methods checked within about 5% at the higher concentration, and the impinger residues were not significant. The EPA complete train generally gave values from 50-200% greater than the ASME method at the low dust concentration, however; and impinger residues constituted a substantial part of the total weight. Efforts to identify and explain the source of the impinger residues were only partially successful. The weight of the residue from the impinger water was often nearly equal to the weight of material collected in the EPA filter during the low dust loading tests. Composition of the residue was largely ammonium sulfate when using ambient temperature evaporation and largely sulfuric acid when using steam bath evaporation. The results from the low dust loading tests using the complete EPA train show the need for extremely careful handling of the equipment and samples to prevent contamination of the sample with minute quantities of extraneous material which can significantly affect calculated dust loading. (Author abstract modified)

**33784** **APTIC NO. 56575**

Slawinska, Danuta and Irena Kruk

**CHEMILUMINESCENT METHODS FOR AIR POLLUTION MONITORING CONTROL.** *(Chemiluminescencyjne metody ciaglej kontroli zanieczyszczen atmosfery). Text in Polish. Chem. Anal. (Warsaw), 18(923): L923-936, 1973.*

Various chemiluminescent methods used for air pollution monitoring control are presented, and the analyzers used for determining ozone, and nitric carbon oxides, sulfur and olefin compounds, and gases affecting the nervous system are discussed. During a chemical reaction, when at least part of the activated particles is neutralized by light emission, chemiluminescence (CL) takes place. Part of the chemical energy is transformed into energy which activates the reaction products. Rodamine B is the best known ozone analyzer. The chemiluminescent detectors for the air pollutants above mentioned are described, and detailed diagrams are presented. In the case of gases affecting the nervous system, the CL detection method has a sensitivity of 0.5 micrograms. It is less accurate than the fluorescent method (0.03 micrograms), but it is more feasible, since no induction source is needed. A very sensitive photometric system should be used for measuring light intensity. Best suited for continuous air control are the analyzers based on CL in the gaseous phase. The American photometers used are less expensive as compared to other analyzers. Scintillating meters can also be utilized for measuring CL intensity. The analyzers mentioned are highly sensitive and selective.

**33785** **APTIC NO. 56523**

Smiley, Vern N.

TUNABLE DYE LASERS FOR AIR POLLUTION MEASUREMENTS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C73-C77. 20 refs.*

The utilization of tunable dye lasers for air pollution measurements is examined. The principle advantage of the dye laser (lidar) for air pollution monitoring is its tunability which permits operation at wavelengths where detector cathodes are efficient and at specific absorption wavelengths where resonance enhanced scattering, fluorescence, and absorption effects may be employed. Use of the resonance Raman effect (operation on an absorption line for the molecule) allows a scattering coefficient several orders of magnitude larger than nonresonant scattering. The resonant Raman scattering coefficient for iodine vapor at 5145 A, for example, is 2.6 times 10 to the 6 times larger than nonresonant Raman scattering in nitrogen at the same wavelength. Pollutants which could be studied with the resonance Raman effect using the dye laser include sulfur dioxide, nitrogen dioxide, and benzene.

**33786** **APTIC NO. 56805**

Smith, R. G., R. J. Bryan, M. Feldstein, B. Levadie, D. C. Locke, F. A. Miller, E. R. Stephens, and P. O. Warner

TENTATIVE METHOD OF ANALYSIS FOR CARBON MONOXIDE--MERCURY REPLACEMENT METHOD. *Health Lab. Sci., 10(4):349-353, Oct. 1973. 6 refs.*

The mercury replacement method is presented as a tentative method for the analysis of carbon monoxide. Particulates, water vapor, and hydrocarbons are removed from an air sample, after which the CO in the sample is reacted with hot mercuric oxide to produce mercury vapor; the mercury is determined photometrically, using the 253.7 nm Hg emission line. The range offered by the method is particularly suited for use in detecting low ambient and natural background CO concentrations; a sensitivity of 1% of full-scale range should be easily attainable. The method is temperature dependent, and any compound or condition which will result in the release of mercury oxide will interfere with the analysis. The precision and accuracy of the method are discussed, as are the apparatus and reagents required, the analytical procedure, the calibration procedure, and the effects of storage.

**33787** **APTIC NO. 56890**

Smith, R. G., R. J. Bryan, M. B. Denton, M. Feldstein, B. Levadie, D. C. Locke, F. A. Miller, E. R. Stephens, and P. O. Warner

TENTATIVE METHOD OF ANALYSIS FOR PHENOLS IN THE ATMOSPHERE (GAS CHROMATOGRAPHIC METHOD). *Health Lab. Sci., 10(4):362-366, Oct. 1973. 4 refs.*

A gas chromatographic method is presented as a tentative method for the analysis of phenols in the atmosphere. Following collection using a fiberglass filter or standard impinger, the phenolic compounds are reacted with sodium hydroxide to form phenates. These compounds are hydrolyzed by acid, and the released phenols are separated from the acid aqueous system by steam distillation. The aqueous solution of the phenols is then analyzed by gas chromatography using a flame ionization detector and a short column. Using phenol as a standard test substance and under the conditions specified herein, the sensitivity of the method is 1 ppm in solution or approximately 40 micrograms/cu m. The method is not subject to interferences by other organic compounds. The precision and accuracy of the method are discussed, along with the apparatus and reagents required, the sampling and analytical procedures, the standardization of the phenol solution, the formula for calculating the total phenolics per cu m of air, and the effects of storage.

**33788** **APTIC NO. 56520**

Spurny, Kvetoslav R., Evelyn R. Ackerman, James P. Lodge, and Irena Tesarova

MODERN PHYSICAL METHODS OF CHEMICAL ANALYSIS OF AEROSOLS: NEW APPLICATIONS OF ANALYTICAL NUCLEPORE FILTERS IN POLLUTED ATMOSPHERE. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C17-C10. 9 refs.*

Ways in which Nuclepore filters (NPF s) have been used for particle sampling, particle size measurement, and chemical analysis of aerosol particles in the highly dispersed aerosol range (10 to the minus 7 to .00001 cm) are reviewed. Application of these filters to the measurement of the concentration and particle size of radioactive aerosols has been accomplished by using two NPF s in series. The radioactivities of the first (upstream) and the second (downstream) filter are measured and the penetration 1-E is calculated. The measurement of the chemical composition of aerosols in the lower stratosphere by means of these filters has also been proposed. Subsequent to measurement of the penetration of aerosol particles of different chemical composition, aerosol diffusivities due to Brownian motion can be obtained, and the particle size of different chemicals can be calculated approximately. Nuclepore filters can also be used to find the size and chemical characterization of atmospheric aerosols more widely dispersed (e.g., 10 to the minus 7 to .0001 cm). Sensitive microchemical analysis methods may be used to measure the weight of the predominant species collected on each filter when a natural heterogeneous aerosol is being sampled. An example is given for samples collected from the atmosphere over Prague. The filters represent a new method of aerosol sampling and analysis complementary to the classical method using membrane filters and are very useful for morphological and microscopic particle analysis.

**33789** **APTIC NO. 56939**

Stavinoha, L. L.

INTERNAL STANDARDS FOR THE ISOLATION AND DETERMINATION OF AROMATICS IN MOTOR GASOLINE. *J. Chromatographic Sci., 11(10):515-520, Oct. 1973. 4 refs.*

Potential internal standards were evaluated for use in a gas chromatographic method for isolating and measuring aromatics in gasolines having final, true boiling points no higher than 486 F (252 C). The precision of the previous direct calibration method relied on a high-pressure/high-temperature liquid sampling valve for precise volume repeatability. Additionally, long-term stability of the hydrogen flame ionization detector sensitivity and an accurately prepared, stable standard for direct calibration were required to ensure precision. Ethyl propionate and 2-pentanone are suitable as internal standards. Thus, the need for the precise sample introduction and external calibration required by the previous method has been eliminated. Sample preparation, response factors, and data reduction techniques were examined for the internal standard method of aromatics determination in gasoline. The use of ethyl propionate as an internal standard was demonstrated in the analysis of several gasolines that have broad aromatic concentration distributions. The results of this method agreed well with those obtained using the previous direct calibration method. (Author abstract)

**33790** **APTIC NO. 56882**

Sugimoto, T.

THE PRESENT PERFORMANCE AND SITUATION OF AN AUTOMOBILE EXHAUST ANALYZER. *(Jidosha haiki gasu bunsei kiki no genjo). Text in Japanese. Junkatsu (J. Japan Soc. Lubrication Engrs.), 18(8):648-652, Aug. 1973. 5 refs.*

Analytic methods for measuring carbon monoxide, hydrocarbons, and nitrogen oxides in automobile exhaust gas are discussed. Non-dispersive infrared spectrometry, flame ionization detectors, chemiluminescence, non-dispersive ultraviolet spectrometry, x-ray fluorescence, and reduction-flame ionization methods are evaluated.

**33791** **APTIC NO. 56525**

Tahara, Shuu

DETERMINATION OF NITROGEN OXIDES IN FACTORY EXHAUST GAS AND ITS PROBLEMS. *(Kojo haigasuchu no sankachisso sokutei to mondaiten). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(10):1105-1110, Oct. 1973.*

The Saltzman method is specified in the Japanese standard for measuring nitrogen oxides. The present method has several problems including that oxidation is insufficient according to the nitric oxide concentration in a 2-hour standing air oxidation and that sulfur dioxide interferes with the measurement. Also, when nitric oxide is completely oxidized by oxygen after removal of SO2, the analytical value is 1.4 times that found in other methods. Thus, the phenoldisulfonic acid method is the international standard method and is becoming standard in Japan. The chemiluminescence, infrared, ultraviolet, and constant potential electrolysis methods are also mentioned.

**33792** **APTIC NO. 56499**

Takeuchi, J. and K. Sato

COMPUTER SYSTEM ATMOSPHERIC DATA PROCESSING IN AICHI PREFECTURE. *(Aichi-ken ni okeru denshikeisanki o riyo shita taiki osen deta shori shisutemu ni tsuite). Text in Japanese. Aichi-ken Kogai Chosa Senta Shoho (Aichi Prefect. Environ. Pollut. Res. Center), no. 1:1-6, March 1973.*

An on-line, real time, pollution monitoring computer system was established in Aichi Prefecture. A telemeter receives the data, determines pollutant concentrations and meteorology, and transmits the data through a sub-system to a mini-computer. Data are displayed on a panel and transmitted to the main center which prints out hourly and daily reports.

**33793** **APTIC NO. 56844**

Tichatschke, Josef and Ulrich Kowalczyk

MEASUREMENT OF HYDROGEN CHLORIDE EMISSIONS IN INCINERATORS - INFLUENCE OF THE FLY ASH ON THE MEASUREMENT RESULTS. *(Messung von Chlorwasserstoff-Emissionen in Muellverbrennungsanlagen Einfluss der Flugasche auf das Messergenis). Text in German. Muell Abfall, 5(5):156-160, 1973. 3 refs.*

The influence of fly ash on the results of measurements of the hydrogen chloride concentration of flue gases from incinerators was studied. The samples were taken in the flue gas duct directly behind the boiler end with a 140 cm long electrically heated quartz probe. The probe was followed by a quartz wool filter with a temperature between 250 and 350 C depending on the flow velocity of the flue gas. The quartz wool did not absorb HCl. Three fritted gas scrubbers filled with 50 to 80 ml water, an empty scrubber, a drying tower, a pump, and a wet gas meter were connected to the filter. For each sample 50 l of flue gas were drawn off with a speed of 5 l/min. The composition of the fly ash was analyzed. Also, the fly ash retained in the filter for preliminary separation was gravimetrically determined. The highest value determined was 1.6 g/cu m. After the first test series taken in the uncleaned gas, a second series was taken in the cleaned gas. In the first test series the chloride increase was determined while the HCl concentration in the flue gas was of secondary importance. In the second test series in the flue gas flow was divided behind the preliminary separator. One branch of the flow was passed over the test filter the other part went directly to the gas scrubbers. At a reaction of HCl with fly ash a difference was to occur between branch one and branch two, which in the ideal case should be identical with the chloride increase in the test filter. The results indicate that the chloride concentration of the fly ash in the test filter increased. A relationship existed between the quantity of fly ash and the quantity of absorbed chloride. The effect on the HCl emission measurement, however, was negligibly small.

**33794** **APTIC NO. 56864**

Wert, Steven L.

DETECTING AND EVALUATING AIR POLLUTION DAMAGE TO FOREST STANDS IN THE UNITED STATES BY USING LARGE-SCALE COLOR AERIAL PHOTOGRAPHY. *Mitt. Forst. Bundesvers., no. 97:281-293, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

Color aerial photography at scales of 1:8000 and 1:1584 has been used successfully to detect and evaluate damage to trees caused by air pollution. Affected tree crowns appear a mottled to uniform yellow in the field and on the photographs. At the largest scale of photography, a didymium filter is used to enhance the contrast between red, green and yellow colors in the tree crowns. Tree crowns also exhibit short needles, fewer needles, and increased branch mortality as symptoms of air pollution damage. These crown characteristics are visible in large scale color aerial photography. In southern California, December through June seems to be the best time for aerial photography in terms of illustrating tree damage. Impact surveys using the aerial photography and a three-stage probability sampling design have been made over two large National Forests in California. Both of these forests are exposed to oxidant air pollution from adjacent metropolitan areas. The number and condition of affected trees were estimated with a high degree of accuracy using the aerial photo sampling system. These surveys were completed at a very modest cost. A similar system is being tested for the evaluation of sulfur dioxide damage to forest in Tennessee. However, no impact surveys have been made to date. (Author abstract modified)

**33795** **APTIC NO. 56855**

White, Kenneth O. and James D. Lindberg

MEASURING THE TRANSMITTANCE OF ATMOSPHERIC DUST IN KBR PELLETS USING A CO2 LASER. *Appl. Opt., 12(11):2544-2545, Nov. 1973. 3 refs.*

The transmittance of atmospheric dust in potassium bromide pellets was measured using a carbon dioxide laser. The results thus obtained were consistently larger than those obtained using a spectrophotometer. This may be explained by a difference in the acceptance aperture of the detectors used. The spectrophotometer has adequate resolution to indicate the qualitative nature of the absorption of the atmospheric dust at laser wavelengths between 9.2 and 10.8 micron. Since atmospheric dust consists of a mixture of many minerals, this conclusion may not be applicable to samples of the pure minerals.

**33796** **APTIC NO. 56560**

Wilder, B., Mirak Fugas, J. Hrsak, and Anica Vukovic

EVALUATION OF THE MODIFIED ANDERSEN CASCADE IMPATOR. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C9-C11. 6 refs.*

Size distribution differences for airborne lead, iron, and managanese particles in relation to the size distribution of total atmospheric particulates in urban and industrial areas during the summer and winter are presented along with results of an investigation concerning the advantages of the glass-fiber filter over aluminum discs in the modified Andersen cascade impactor. Mass mean diameters (MMD) of total suspended particulates, lead, iron, and manganese in a lead smelter area were significantly higher in samples collected on glass-fiber filters, and an analysis of the difference in the mass distribution by stages of particles collected in corresponding samples on the two sampling media indicated that a significant difference is most often found in the first two impaction stages and on the back-up filter. There was a significant difference betewen MMDs for lead, iron, and manganese particles collected on either media in the urban and industrial area, though this did not hold for total particulates. A significant difference was also found between MMDs of total and lead particles and of iron during the summer in the urban area. There does not appear to be enough evidence from the the present data to confirm a significant difference between MMDs of total particulates and the three examined.

**33797** **APTIC NO. 56720**

Wright, M. L.

FEASIBILITY STUDY OF IN-SITU SOURCE MONITORING OF PARTICULATE COMPOSITION BY RAMAN OR FLUORESCENCE SCATTER (FINAL REPORT). *Stanford Research Inst., Menlo Park, Calif., Environmental Protection Agency Contract 68-02-0594, SRI Proj. 2039, Program Element No. 1A1010, EPA-R2-73-219, 121p., June 1973. 11 refs.*

NTIS: PB 225042/1AS

The feasibility of in-stack monitoring of an air-suspended particulate stream by fluorescence or Raman optical interactions was assessed. The study explored the feasibility of two approaches: quantitatively monitoring a prescribed constituent, and monitoring the relative concentrations of several constituents simultaneously. Fluorescence-monitoring systems were found suitable for the latter. Investigation of 34 materials revealed 13 with significant fluorescent responses and 22 with measurable Raman responses. All 13 materials could be detected by fluorescence systems (although few could be uniquely identified), and 15 of the 22 Raman-active materials could be detected by a Raman system when these responses were used to calculate in-stack detectability. Both methods of in-stack monitoring appear to yield useful information about the quantity and composition of a particulate stream. Recommendations are made for additional effects toward achieving an operational in-stack monitoring system. (Author abstract modified)

**33798** **APTIC NO. 56911**

Yavorovskaya, S. F. and L. P. Anvayer

GAS-CHROMATOGRAPHIC DETERMINATION OF XYLENES, BROM-O-XYLENE, 3,4-XYLIDINE, AND 4,6-DIBROM-O-XYLENE IN THE AIR. *(Gazokhromatograficheskoye opredeleniye ksilolov, brom-o-ksilola, 3,4-ksilidina i 4,6-dibrom-o-ksilola v vozdukhe). Text in Russian. Gigiena i Sanit., no. 8:64-65, 1973. 3 refs.*

A gas-chromatographic method for the joint determination of xylenes, brom-o-xylene, 3,4-xylidine, and 4,6-dibrom-o-xylene in the air, such as occurring in vitamin manufacture, is described. The air sample is taken at a rate of 1.5 l/min through a small absorber containing chromatographically pure n-decane as the solvent. A chromatographic column of 240 cm length with Chromatone N-AWDMCS filling, containing 15% apiezone L as stationary phase, an initial column temperature of 130 C, a final temperature of 170 C, and a carrier gas flow rate of 40 l/min were best for the gas-chromatographic determination. The limits of detectability, determined for o-xylene, brom-o-xylene, 3,4-xylidine, and 4,6-dibrom-o-xylene, are 0.00007 mg, 0.00011 mg, 0.00028 mg, and 0.00012 mg, respectively.

**33799** **APTIC NO. 56369**

Young, Marilou, John N. Driscoll, and Kimball Mahoney

POTENTIOMETRIC DETERMINATION OF SULFUR DIOXIDE IN FLUE GASES WITH AN ION SELECTIVE LEAD ELECTRODE. *Anal. Chem., vol. 45:2283, Nov. 1973. 9 refs.*

Samples which were collected from a number of stationary sources that emit sulfur dioxide were analyzed with standard lead (at plus 2) ion using potentiometric titrations and Gran s plots to determine the quantity of sulfate ion; the sulfate samples were also analyzed by the barium ion-thorin titration and the barium chloranilate methods for comparison. The potentiometric titration procedure gave results in good agreement with the latter two methods, while Gran s plot method produced erratic results. The correlation coefficients between the barium methods and the lead titration were higher than those for the lead (Gran s plots). The lead potentiometric method had a slope which was only 2-4% from unity, while the Gran s plots slopes deviated 15% from unity compared to the other two wet chemical methods for sulfate. The Gran s plot method does not appear to be very useful for sulfate determinations in this application, but the potentiometric titration procedure yields good agreement with the other two wet chemical methods for sulfate.

**33800** **APTIC NO. 56569**

Zajontz, Joachim, Hans Henning Oelert, and Bodo Block

DEVELOPMENT AND TRIAL OF A TEST PROCEDURE FOR DIESEL VEHICLE EXHAUST EMISSIONS. *(Entwicklung und Erprobung eines Pruefverfahrens fuer die Abgasemissionen von Dieselfahrzeugen). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C56-C59. 5 refs.*

Preliminary studies concerning the standardization of a test procedure for diesel vehicle exhaust emissions are described and compared with the 13-mode test adopted in the USA. The carbon monoxide, nitric oxide, nitrogen dioxide, total hydrocarbon, and carbon dioxide emissions of a direct-injection/engine and of another prechamber diesel engine under stationary and non-stationary conditions were measured. The NO emissions occurring during acceleration were found to be lower than those occurring under stationary full load conditions. The NO emission from the prechamber diesel were far below those produced by the direct-injection engine. Diesel engine-powered trucks equipped with recording instruments for the operating conditions were driven to establish the statistical distribution of the individual operating and load conditions in practice. Some 90% of the total driving time fell on the acceleration and deceleration phases, with the residual 10% corresponding to uniform speed. Compared with the 13-mode test, an even distribution of all operating conditions is thus unrealistic. Exhaust measurements during predetermined stationary and non-stationary phases as a simulation of route sections on a test stand, or the selection and evaluation of defined points from the emission characteristics appear to be realistic approaches to diesel engine exhaust testing.

## 1972

**33801** **APTIC NO. 56782**

Adams, Donald F.

ANALYSIS OF POLLUTANTS CONTAINING SULFUR--STATUS REPORT OF THE INTERSOCIETY SULFUR SUBCOMMITTEE. *12p., 1972. 10 refs. (Presented at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 23rd, Cleveland, Ohio, March 6-10, 1972.)*

The Sulfur Compound Subcommittee of the Intersociety Committee has published a number of tentative sulfur measurement methods which it has reviewed and standardized, and it is currently actively considering a number of others. Among the published methods is a manual colorimetric method for sulfur dioxide identification; this method includes two variations of the original West-Gaeke procedure, one of which is the method of choice, the other of which is easier to perform. Although the subcommittee regards the conductimetric method as unsuitable as a standard procedure, it has published a consensus method for the manual conductimetric determination of

SO2. This method is simple, flexible, and economical, but it allows for many interferences. Two nondiscriminatory methods have also been published: the lead peroxide sulfation candle and plate procedures. These methods should be considered to reflect only a qualitative effect, rather than a quantitative measure of SO2. A significant proportion of the subcommittee s efforts has been directed toward the development of a flexible and all-embracing systems approach to the problem of defining the functions of automatic analysis and recording instruments. The conductimetric principle for the determination of SO2 was chosen as a model for the systems approach to the preparation of a tentativy standard for an automatic analysis and recording instrument. The list of sulfur methods has recently been expanded to include the determination of source concentrations of SO2 and sulfur trioxide. Work is being continued in the preparation of tentative standards for source measurements.

**33802** **APTIC NO. 56675**

Araktingi, Yvon E.

DETERMINATION OF SELECTED ATMOSPHERIC POLLUTANTS BY ATOMIC FLUORESCENCE AND X-RAY PHOTOELECTRON SPECTROSCOPY. *Louisiana State Univ. and Agricultural and Mechanical College, Dept. of Chem., Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1972. 179p. 172 refs.*

The feasibility of utilizing atomic fluorescence spectroscopy for the direct determination of cadmium and mercury in the atmosphere was studied. An instrument was constructed incorporating a flameless atomizer of graphite rods heated to around 1200 C. Carbon monoxide, which was produced when air was passed over the rods, reduced the mercury and cadmium compounds present to the atomic state. These atoms became optically excited upon being introduced to light from a monochromatic source. Fluorescent light was emitted as a fraction of the excited atoms lost their energy by radiational processes; the intensity of the fluorescent signal was directly proportional to the concentration of absorbing atoms. Low intensity fluorescent signals were produced due to the quenching effect of nitrogen and CO on the signals of mercury and cadmium. The x-ray photoelectron spectroscopy was then used to determine the chemical forms of several metallic and nonmetallic elements present in airborne particulates. Electrons were emitted from the various atoms within an air sample as it was subjected to high energy x-ray bombardment. The binding energy of these electrons was characteristic of the various elements present and was a function of the chemical environment of the element in question. Oxygen, aluminum, silicon, iron, sulfur, lead, chlorine, carbon, calcium, and nitrogen were observed in the spectrum of airborne particulates. Detailed analyses were conducted for nitrogen, lead, and sulfur. (Author abstract modified)

**33803** **APTIC NO. 56247**

Bowman, Lloyd D. and Richard F. Horak

A CONTINUOUS ULTRAVIOLET ABSORPTION OZONE PHOTOMETER. *Anal. Instrum., vol. 10:103-108, 1972. 21 refs. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72430.)*

A continuous ultraviolet ozone monitor whose output correlates well with the 1% neutral buffered potassium iodide procedure was developed. It measures O3 concentration levels from 0.003 ppm to 20.00 ppm. The instrument utilizes the proportional intensity changes of an ultraviolet beam as it traverses a fixed path containing O3. It is basically comprised of a 2537 A monochromatic ultraviolet source, a sample chamber, an ultraviolet detector, and a signal processing and readout system. Two reference subsystems provide a high degree of stability by correcting for source intensity, optical path transmittance, and detector response changes. Self zeroing is accomplished by comparison of the sample and reference readings. Automatic span adjustment is achieved electronically. (Author abstract modified)

**33804** **APTIC NO. 56244**

Ciosek, Aleksandra and Irena Kesy-Dabrowska

DETERMINATION OF FLUORINE COMPOUNDS IN THE AIR. *(Oznaczanie zwiazkow fluoru w powietrzu). Text in Polish. Med. Pracy, 23(6):585-594, 1972. 26 refs.*

A selective absorption colorimetric method for the determination of hydrogen fluoride, inorganic fluorides, and fluorosilicates in the air is presented. The method consists of passing air through a membrane filter and then through a sodium hydroxide solution and determining the fluorides colorimetrically in a reaction with zirconium oxychloride (ZrOCl2) and sodium para sulfophenylazochromotropate. Microdiffusion is used to eliminate cations interfering with the determination. Routine laboratory tests of the method were performed, and recovery of fluoride was almost 100%.

**33805** **APTIC NO. 56681**

Epstein, B. D.

ELECTROCHEMICAL METHODS OF POLLUTION ANALYSIS. *In: Electrochemistry of Cleaner Environments. John O M. Bockris (ed.), New York, Plenum Press, 1972, Chapt. 6, p. 165-206. 162 refs.*

Electrochemical analysis techniques for water and air pollution monitoring of ozone, oxides of nitrogen, sulfur oxides, carbon monoxide, and fluorides and fluorine are reviewed. The biggest shortcoming of redox electrochemical techniques, voltammetry, amperometry, and coulometry, is the requirement of extensive sample pretreatment in the form of reagent addition and deoxygenation. Sometimes this drawback can be eliminated by continual reuse or regeneration of reagents or by self-contained generation of hydrogen to be used for deoxygenation. Specificity in the case of selective ion electrodes is not always dependable, and there are additional effects from complexation and ionic strength that obscure the analysis. Electrochemical techniques, though admirable under laboratory conditions, appear to be a long way from on-line analysis.

**33806** **APTIC NO. 56250**

Fontenot, J. L.

KRAFT BOARD ODOR EVALUATION BY GAS CHROMATOGRAPHY AND AN ODOR JUDGING PANEL. *TAPPI, 55(4):599-601, April 1972. 13 refs. (Presented at Technical Association of the Pulp and Paper Industry, Testing Conference, Savannah, Ga., Oct. 5-8, 1971.)*

Paperboard odor levels were evaluated by gas-liquid chromatography (GLC) using head space sampling techniques. Samples were rated according to relative response factors of the odoriferous components. A good agreement was obtained between the GLC method and an odor judging panel. The method was used to study the possible sources of odors in pulp. It was also used to show that a functional coating had been improperly cured. (Author abstract)

**33807** **APTIC NO. 56440**

Giauque, Robert D., Fred S. Goulding, Joseph M. Jaklevic, and Richard H. Pehl

TRACE ELEMENT ANALYSIS WITH SEMICONDUCTOR DETECTOR X-RAY SPECTROMETERS. *University of California, Berkeley, Lawrence Berkeley Laboratory, U. S. Atomic Energy Commission Contract 72-0936-6, 57p., June 1972. 20 refs. (Presented at the Society for Applied Spectroscopy, National Meeting, Dallas, Tex., Sept. 10-15, 1972.)*

NTIS: LBL-647

A method of obtaining high sensitivity and precision in x-ray fluorescence analysis using semiconductor detector spectrometers is discussed. Monoenergetic exciting radiation is employed to generate characteristic x-rays from trace elements in thin, uniform specimens. Results obtained in the analyses of biological and geological specimens, and of air particulate filters are reported. Using a single excitation energy, the concentrations of more than 15 trace elements may be simultaneously determined during a 15-minute interval for concentrations of 1 ppm or less. This corresponds to less than 10 ng/sq cm on air particulate filters. (Author abstract modified)

**33808** **APTIC NO. 56794**

Gilardi, E. F. and Howard F. Schiff

COMPARATIVE RESULTS OF SAMPLING PROCEDURES USED DURING TESTING OF PROTOTYPE AIR POLLUTION CONTROL DEVICES AT NEW YORK CITY MUNICIPAL INCINERATORS. *American Society of Mechanical Engineers, New York, Proc. Natl. Incinerator Conf., New York, 1972, p. 102-110. 1 ref. (June 4-7.)*

Comparison tests of gas sampling train techniques as recommended by the American Society of Mechanical Engineers and the Environmental Protection Agency, Office of Air Programs (OAP) were conducted on three different prototype air pollution control systems at three different multi-furnace incinerator plants. Simultaneous particulate loading, preceding and following the prototype air pollution control systems, as well as simultaneous sampling with the ASME and OAP techniques were examined. Plots for the normal probability distribution of particulate emissions at scrubber outlet show a higher catch for the OAP train than for the ASME type; however, there is no assurance that the higher catch represents physical particulate matter. Data for the total catch (probe and filter plus impingers) reported by the OAP test train plotted against the probe and thimble catch reported by the ASME train indicate that the OAP catch exceeds the ASME catch by more than 20%. Elimination of the impinger catch from the results of the OAP train brings the points falling above the equal catch line much closer together and closer to the line. The impinger catch may have represented fume catch condensed in the impingers or reaction products of gaseous compounds in the flue gas. The higher efficiency of the OAP filter over the ASME thimble resulted in the average OAP probe and filter catch remaining 7% greater than the ASME catch. The OAP probe and filter catch average from 10 to 20% greater than the ASME probe and thimble catch.

**33809** **APTIC NO. 56339**

Hulett, L. D., T. A. Carlson, B. R. Fish, and J. L. Durham

STUDIES OF SULFUR COMPOUNDS ADSORBED ON SMOKE PARTICLES AND OTHER SOLIDS BY PHOTOELECTRON SPECTROSCOPY. *In: Determination of Air Quality. Gleb Mamantov and W. D. Shults (eds.), New York- London, Plenum Press, 1972, p. 179-187. 4 refs. (Presented at the American Chemical Society Symposium on Determination of Air Quality, Los Angeles, Calif., April 1-2, 1971.)*

Photoelectorn magnetic spectroscopy (x-ray source) as a means of air pollution monitoring and as a tool for smoke pollution research was studied by analyzing field samples of fly ash from a power plant and smoke particles from a home furnace. The determination of the oxidation states of sulfur in compounds adsorbed on these solids was possible, and the variables in furnace operation such as combustion efficiency are important. A high proportion of the sulfur compounds on the surfaces of coal smoke particles produced in low-combustion home furnaces was in the more reduced sulfide and sulfite states; whereas sulfur species on the fly ash specimen, taken from a high-efficiency power plant, were all in the more highly oxidized sulfate form. The composition of the solid on which sulfur dioxide is adsorbed was found to be an important variable in the rate at which oxidation to sulfate occurs. (Author abstract modified)

**33810** **APTIC NO. 56796**

Katz, M.

INTERSOCIETY COMMITTEE METHODS OF AMBIENT AIR SAMPLING AND ANALYSIS. *Preprint, American Industrial Hygiene Assoc., 15p., 1972. (Presented at the American Industrial Hygiene Association, Conference, San Francisco, Calif., May 15-19, 1972.)*

The Intersociety Committee methods of ambient air sampling and analysis are summarized in a manual of methods published by the American Public Health Association, Part 1 contains 19 sections devoted to descriptions of laboratory precautions and techniques, including physical precautions, calibration procedures, sampling and storage of aerosols and gases, reagent water and common standard solutions, recovery and internal standard procedures, interferences, general procedures for photometric methods, ultraviolet and infrared spectroscopy, atomic absorption spectroscopy, gas chromatography, and radioactivity. The use and care of volumetric glassware, precision and accuracy, and general safety practices. Part 2 consists of the 57 methods, subdivided into the following classes: carbon compounds consisting of hydrocarbons, polycyclic compounds and other organic compounds as aldehyde, mercaptans, phenols, peroxyacetyl nitrate, and carbon monoxide; halogens and halogen compounds; metals; oxidants and inorganic nitrogen compounds; particulate matter; radioactivity; and sulfur compounds. Part 3 contains a section dealing with recommended factors and conversion units for analysis of air pollutants. All methods were designated as tentative until sufficient collaborative testing is done. (Author abstract modified)

**33811** **APTIC NO. 56323**

Kubicek, K., J. Liskova, and I. Lisek

DETERMINATION OF THE CARBON DIOXIDE CONCENTRATION IN THE AIR OF STABLES USING A 15-TYPE CARBON DIOXIDE DETECTION TUBES. *(Stanoveni koncentrace kyslicniku ve stajoven vzduchu detekcnimi trubickami CO2--typ 1%). Text in Czech. Veterinaria Medicina, 17(45):517-525, 1972. 8 refs.*

Detection tube and interferometric orientation methods of carbon dioxide determination in the air were compared with the standard titration method using barium hydroxide according to Subbotin-Nagorsky. In laboratory conditions the admissible deviation of + or 30% was exceeded by 42.3% of the detection tube analysis and by 14.3% of the interferometer analysis. In stable conditions both methods gave still higher deviations for the concentrations of 0-0.4% CO2 in the stable air. In 91.3% of all cases measured by the detection tubes the results were higher than by the titration method.

**33812** **APTIC NO. 56816**

Matsuoka, S., T. Kitamura, T. Ogura, M. Katada, N. Osaki, and S. Shimomura

STUDIES OF THE AUTOMATIC DETERMINATION OF HYDROGEN SULFIDE. *(Ryuka suiso no jido sokutei ho no kenkyu). Text in Japanese. Tokushima-ken Eisei Kenkyusho Nenpo (Ann. Rept. Tokushima Prefect. Public Health Lab.), no. 11:71-72, May 1972. 3 refs.*

Hydrogen sulfide automatic measurement methods were studied including methylene blue, fluorescence, gas chromatographic flame photometry, ion electrode, and lead acetate tape. Problems of these methods are discussed. The lead acetate method was the only method which could be accurately used for automatic measurement of H2S.

**33813** **APTIC NO. 56248**

McAnulla, R. H. and E. A. Houser

NEW DEVELOPMENTS IN SAMPLING SULFUR RECOVERY TAIL GAS. *Anal. Instrum., vol. 10:127-129, 1972. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, Paper 72434.)*

A new simplified lower cost sampling system for sampling sulfur recovery tail gas was designed. The system can be located in the analyzer unit, eliminating the need for a separate heated box. By combining low flow design with a stream flush, exposure to the sample is greatly reduced and much better service life is obtained. Field installations of these newer units have proven very successful, with accurate analysis and less maintenance. The system measures sulfur dioxide and hydrogen sulfide. (Author abstract modified)

**33814** **APTIC NO. 56246**

McClatchie, E. A., A. B. Compher, and K. G. Williams

A HIGH SPECIFICITY CARBON MONOXIDE ANALYZER. *Anal. Instrum., vol. 10:67-69, 1972. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72416.)*

A new technique for measuring trace quantities of carbon monoxide by the nondispersive infrared method is described. The technique uses the property of infrared fluorescence in a gas to generate a specific course of radiation which is an exact match of the absorption spectrum of the fundamental band of CO. This results in an instrument with high sensitivity and specificity for CO. A novel method of referencing using an isotopic species of CO confers great stability on the instrument. (Author abstract modified)

**33815** **APTIC NO. 56300**

McMillan, R. D., Jr.

APPLICATIONS OF A PRECISION OZONE GENERATOR IN CALIBRATION OF OZONE/OXIDANT ANALYZERS AND INLET SAMPLE AIR SYSTEMS. *Anal. Instrum., vol. 10:61-66, 1972. 5 refs. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72415.)*

Applications of precision ozone generator in calibration of O3/oxidant analyzers and inlet sample air systems are described. The principle loss of O3 concentration through a clean inlet tube system is caused by the exponential decaying loss of O3 in air with respect to time. The ideal inlet tube system transports the inlet air sample to the O3 monitor without time lag. The loss for finite time lag is given for an O3 concentration level of 1 ppm. Test data show that at correspondingly lower levels of O3 concentration, a greater percent of reading losses can be expected for a given transport time. At 1.0 ppm the decay time constant is approximately 2.2 min. In applying an O3 generator as a dynamic calibration source, continuous operation of the O3 source appears to produce the best long term stability. Ideally the calibration gas should be introduced at the inlet to the inlet tube system rather than directly into the O3 monitor for highest data accuracy. (Author conclusions modified)

**33816** **APTIC NO. 56436**

Monkman, J. L., A. Zdrojewski, and L. Dubois

DETERMINATION OF AIRBORNE PARTICULATE MANGANESE BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. *Environmental Protection Service, Ottawa (Ontario), Canada, Air Pollution Control Directorate, Rept. EPS 4-AP-72-9, 26p., Dec. 1972. 6 refs.*

The accurate measurement of manganese present in airborne particulate matter is described. Samples of airborne particulates are taken by high volume or low volume techniques, drawing a measured volume of air through dry filter media. The filter materials that are used may include washed glass fiber, analytical grade cellulose or organic membrane filters. The filter, or an areal aliquot thereof, with collected particulates, is wet ashed and the acid digest is made up to a standard volume with water. If microgram sensitivity is sufficient, the manganese in the prepared sample is very rapidly assayed by atomic absorption spectroscopy, operating in the flame mode. If nanogram sensitivity is required and reduced analytical output can be accepted, then atomic absorption analysis may be done with the graphite furnace. (Author abstract)

**33817** **APTIC NO. 56437**

Monkman, J. L., A. Zdrojewski, and L. Dubois

DETERMINATION OF AIRBORNE PARTICULATE CADMIUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. *Environmental Protection Service, Ottawa, Ontario (Canada), Air Pollution Control Directorate, Rept. EPS 4-AP-72-5, 28p., Dec. 1972. 7 refs.*

The accurate measurement of cadmium present in airborne particulate matter is described. Samples of airborne particulates are taken by high volume or low volume techniques, drawing a measured volume of air through dry filter media. The filter materials used can include washed glass fiber, analytical grade cellulose, or organic membrane filters. The filter, or an areal aliquot thereof, with collected particulates, is wet ashed and the acid digest is made up to a standard volume with water. If microgram sensitivity is sufficient, the Cd in the prepared sample is very rapidly assayed by atomic absorption spectroscopy, operating in the flame mode. If nanogram sensitivity is required, and reduced analytical output can be accepted, then atomic absorption analysis may be done with the graphite furnace. (Author abstract)

**33818** **APTIC NO. 56438**

Monkman, J. L., A. Zdrojewski, N. A. Quickert, and L. Dubois

DETERMINATION OF AIRBORNE PARTICULATE VANADIUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. *Environmental Protection Service, Ottawa, Ontario (Canada), Air Pollution Control Directorate, Rept. EPS 4-AP-72-8, 20p., Dec. 1972. 7 refs.*

The accurate measurement of vanadium present in airborne particulate matter is described. Samples of airborne particulates are taken by high volume or low volume techniques, drawing a measured volume of air through dry filter media. The filter materials that are used may include washed glass fiber, analytical grade cellulose, or organic membrane filters. The filter, or an areal aliquot thereof, with collected particulates, is wet ashed and the acid digest is made up to a standard volume with water. If microgram sensitivity is sufficient, the vanadium in the prepared sample is very rapidly assayed by atomic absorption spectroscopy, operating in the flame mode. If nanogram sensitivity is required and reduced analytical output can be accepted, then atomic absorption analysis may be done with the graphite furnace. (Author abstract)

**33819** **APTIC NO. 56454**

Monkman, J. L., A. Zdrojewski, and L. Dubois

DETERMINATION OF AIRBORNE PARTICULATE LEAD BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. *Environmental Protection Service, Ottawa, Ontario (Canada), Air Pollution Control Directorate, Rept. EPS 4-AP-72-1, 27p., Dec. 1972. 6 refs.*

The accurate measurement of lead present in airborne particulate matter is described. Samples of airborne particulates are taken by high volume or low volume techniques, drawing a measured volume of air through dry filter media. The filter materials that are used may include washed glass fiber, analytical grade cellulose, or organic membrane filters. The filter or an areal aliquot thereof, with collected particulates, is wet ashed and the acid digest is made up to a standard volume with water. If microgram sensitivity is sufficient, the Pb in the prepared sample is very rapidly assayed by atomic absorption spectroscopy, operating in the flame mode. If nanogram sensitivity is required, and reduced analytical output can be accepted, then atomic absorption analysis may be done with the graphite furnace. (Author abstract)

**33820** **APTIC NO. 56301**

Palanos, P. N.

A PRACTICAL DESIGN FOR AN AMBIENT CARBON MONOXIDE MERCURY REPLACEMENT ANALYZER. *Anal. Instrum., vol. 10:117-125, 1972. 10 refs. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72433.)*

Parameters that control the sensitivity, selectivity, and speed of response of mercury replacement analyzers are discussed. The essential features of a 1% accuracy, 1% stability instrument based on mercury replacement combined with atomic absorption are presented. The reactor temperature should be set as low as possible and regulated to within 0.5 C. The pressure in the reactor must be stabilized to better than 0.5%. A nonporous pellet of mercuric oxide should be used and all surfaces exposed to the gas flow. The pellet mass should be large enough to minimize the rate of change of surface area with consumption. The conversion yield of Hg vapor for the CO reduction reaction should be adjusted to a maximum value of 105. The flow rate of filtered air to the reactor must be controlled to better than 0.5%. Inlet CO containing air must be dried to lower the moisture content to less than 1 ppm. Hydrocarbon interferences heavier than methane must be removed. Optical system stability of better than 0.5% is required. The essential features of a practical CO analyzer are described. (Author abstract modified)

**33821** **APTIC NO. 56303**

Parts, Leo, Arthur D. Snyder, Paul L. Sherman, and Frederic C. Jaye

A REVIEW OF INSTRUMENTAL TECHNIQUES FOR MONITORING NITROGEN OXIDES EMISSIONS FROM STATIONARY SOURCES. *Anal. Instrum., vol. 10:157- 163, 1972. 28 refs. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72440.)*

Instrumental techniques for monitoring nitrogen oxides emissions from stationary sources are reviewed and evaluated. The commercially available instruments are based on nondispersive infrared absorption, photometry, chemiluminescence (nitric oxide and ozone), and voltammetric (electrochemical) measurements. Four additional instruments, based on optical principles, are at the advanced commercial development or early commercialization stage. Technology and background information exist for evaluating the practical utility of a second chemiluminescence technique (nitrogen oxides and oxygen), correlation spectrometry, mass spectrometry, and selective photoionization for continuous NOx emission monitoring. Resonance absorption of semiconductor laser radiation, laser Raman scattering, and vibrational fluorescence are visualized as potentially useful techniques based on the evolving laser technology. Most monitoring systems that have been identified are optical instruments.

**33822** **APTIC NO. 56254**

Poli, A. A. and T. L. Zinn

ECONOMICAL ZERO AND REFERENCE GAS FOR ANALYTICAL INSTRUMENTATION. *Anal. Instrum., vol. 10:109-116, 1972. 6 refs. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72432.)*

A simple low cost device utilizing a two stage catalytic bed system for the removal of contaminants from atmospheric air is discussed. The device allows calibration and long term operation of gas analysis instrumentation without the necessity of using and handling expensive zero gas cylinders. Long term operating data is included with listing of in use applications and operating parameters of gas analysis instrumentation. Catalytic conversion of all hydrocarbons, including methane was achieved to a level less than .1 ppm while carbon monoxide was removed to a level of less than 1 ppm from a stream of atmospheric air with a flow rate up to 10 standard cu ft/hr. The air introduced did not contain more than 100 ppm hydrocarbons, as methane, and no more than 500 ppm CO. (Author abstract modified)

**33823** **APTIC NO. 56253**

Raillere, Raymond and Georges Fulachier

PORTABLE APPARATUS FOR THE DETERMINATION OF PHOSPHINE IN AIR. *(Messgeraet fuer Phosphorverbindungen in Luftatmosphaere). Text in German. (Etat Francais, vertreten durch den Staatsminister fuer nationale Verteidigung, Paris (France)) W. Ger. Pat. Appl. 2,229,948. 14p., June 20, 1972. (6 claims).*

A portable apparatus for the determination of phosphine in air is described. In the apparatus, based on the spectrometry of the 526 nm phosphorus emission line in flames of air-hydrogen mixtures, excess H2 was used for a high signal noise ratio and burned in a second burner. The sensitivity for PH3 in the absence and presence of other impurities was 0.5 and 200 ppb respectively.

**33824** **APTIC NO. 56762**

Reiszner, Kenneth Dean

SPECTROPHOTOMETRIC DETERMINATION OF AVERAGE CONCENTRATION OF SULFUR DIOXIDE IN AIR BY PERMEATION THROUGH POLYMER MEMBRANES. *Louisiana State Univ. and Agricultural and Mechanical College, Dept. of Chemistry, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1972. 93p. 35 refs.*

A new method for measuring the average concentration of sulfur dioxide is presented. It consists of a simple sampling procedure coupled with the West-Gaeke procedure for the subsequent determination of the trapped SO2. For the analysis of air, a glass tube covered on one end with a silicone rubber membrane and stoppered on the other end, is filled with a solution of 1.0 M sodium tetrachloromercurate (II). When the tube is exposed to air containing SO2, the SO2 permeates through the membrane and is absorbed by the sodium tetrachloromercurate (II) solution. After the solution in the tube is returned to the laboratory, it may be analyzed by the West-Gaeke method by adding the color-developing solutions of formaldehyde and acid- bleached pararosaniline and measuring the absorbance at 575 nm. With an 11 sq cm membrane exposed for 1 day, a detection limit of 10 micrograms/cu m can be projected. The method is low in cost and essentially free of interferences. Average concentrations are provided for each selected exposure period, thereby relating directly to Federal or State standards. (Author abstract modified)

**33825** **APTIC NO. 56251**

Rosenthal, Kermit and Robert J. Bambeck

CONTINUOUS MONITORING OF STACK GASES. *Anal. Instrum., vol. 10:45-48, 1972. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72411.)*

The operation of a new in-stack optical instrumentation system for continuous monitoring of stack gases is described. This instrumentation was installed and is in operation on 27 central station utility boilers of the Southern California Edison Co. for monitoring nitric oxide. The equipment concept, applications, and real time operating experience at the eight plants of the Southern California Edison Co. are described. The instrumentation is within accuracy specifications and exceeds the requirements of Environmental Protection Agency for standards of performance for new stationary sources. The response time of the system reading is approximately 4 sec. (Author abstract modified)

**33826** **APTIC NO. 56320**

Schamp, N. and F. van Wassenhove

DETERMINATION OF BENZO(A)PYRENE IN BITUMEN AND PLANTS. *J. Chromatog., 69(2):421-425, 1972. 17 refs.*

Successive thin layer chromatography separations on a silica gel, cellulose (reversed), and acetylcellulose gave complete separation of benzo(a)pyrene from bitumen and fuel oils. Bitumen is used in an emulsion as a soil conditioner and fuel oils are used as herbicides and in fertilizers. Extracts of plants which have been grown on soils treated with various petroleum fractions are studied. The extensive separation is necessary to avoid false positive results. The separation also allows determinations to be made by fluorimetry, which is about 200 times more sensitive than ultraviolet spectrometry. Since carcinogenicity can depend on the presence of several polycyclic aromatic hydrocarbons, reliable methods must also be established for the other highly carcinogenic components of petroleum fractions. (Author conclusions modified)

**33827** **APTIC NO. 56313**

Schuetzle, Dennis

COMPUTER CONTROLLED HIGH RESOLUTION MASS SPECTROMETRIC ANALYSIS OF AIR POLLUTANTS. *Washington Univ., Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1972. 197p., 38 refs.*

A computer-controlled high resolution mass spectrometric analytical method for identifying air pollutants was developed and utilized in a study of the composition of Seattle aerosols collected with a six stage Anderson sampler. The concentrations of ammonium bisulfate, sodium nitrate, and ammonium chloride in the aerosols depended on the particle size. The newly developed mass spectrometric method and a gas chromatograph/low resolution mass spectrometer/computer system were used to study the composition of southern California urban, mixed urban, and marine aerosols as a function of time and particle size.

**33828** **APTIC NO. 56298**

Snyder, Arthur D., Paul L. Sherman, Edward C. Eimutis, Frederic C. Jaye, and Michael G. Konicek

LABORATORY AND FIELD EVALUATION OF STATIONARY SOURCE INSTRUMENTATION FOR OXIDES OF NITROGEN EMISSIONS. *Anal. Instrum., vol. 10:165-173, 1972. 3 refs. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72441.)*

The performance of seven commercial monitors for application to the continuous determination of nitrogen oxides from stationary sources was evaluated in laboratory and field tests. Based on the present and projected requirements for monitoring instrumentation, utility factors and ranges of performance were first established for each of 15 performance parameters. The comparison of the evaluation data on each performance parameter with the desired performance matrix resulted in an estimate of the overall performance of the tested nitrogen oxide monitors. The evaluation results indicate that current monitors exhibited performance indices ranging from 0.57 to 0.78 versus a potential value of 0.99 for an instrument meeting all of the desired performance values. The instruments were based on chemiluminescence, correlation spectroscopy, inverse radioactive tracing, selective photoionization, nondispersive infrared spectrometry, visible absorption, and electrochemical methods. (Author abstract modified)

**33829** **APTIC NO. 56257**

Syrota, J.

CHAPTER II: THE MEASUREMENT OF AIR POLLUTION. *(Chapitre II: La mesure de la pollution atmospherique). Text in French. Pollut. Atmos. (Paris), no. special:17-34, July 1972.*

Some problems in the apparative measurement of air pollution (sulfur dioxide and black smoke) are described, as well as some of the apparatus generally used. The SF1 and SF8 measure components by micrograms/sq m, sampling by electric pumping with continuous gas flow generally at 84 l/hr. The AFG has a precision of 15 micrograms/cu m/hr for SO2, now being replaced by the AF2 which requires less maintenance. The Philips SO2 detector measures using coulometry and bromine titration with gas flow of 150 ml/mn. The pararosaniline method measures SO2 absorbed in potassium tetrachloromercurate. This method is used by Technicon (Monitor IV) and the color-gas apparatus with precisions of 15 micrograms/cu m and 20 micrograms/cu m respectively. Carbon monoxide is measured by the ONERA 80 and ANIR 11 which depends on the absorbability of CO in infrared. Dust fallout is measured by depot and Owen gauges and DIEM plates of aluminum fixed on a stainless metal base and coated with vaseline for 1-2 week exposure. The dust separator CPA is also described as well as some colorimetric techniques for nitrogen oxide measurement.

**33830** **APTIC NO. 56272**

Taczalska, Wanda

I. SELECTION OF CHROMATOGRAPHIC COLUMNS FOR SEPARATION OF ALIPHATIC HYDROCARBONS FRACTION C1-C4 INCLUSIVE AND DETERMINATION OF OPTIMUM PARAMETERS FOR THESE COLUMNS. II. METHODS OF AIR SAMPLES COLLECTION AT WORK POSTS AND DETERMINATION OF TRACE QUANTITIES OF ALIPHATIC HYDROCARBONS LIGHT FRACTIONS. *(I. Opracowanie optymalnych parametrow oraz dobor kolumn chromatograficznych dla rozdzialu frakcji weglowodorow alifatycznych C1-C4 wlacznie II. opracowanie metodyki poboru i oznaczania prob powietrza pomieszczen produkcyjnych na zawartosc sladowych ilosci lekkich frakcji weglowodorow alifatycznych). Text in Polish. Med. Pracy (Warsaw), 23(6):595-603, 1972. 5 refs.*

Methods of air sample collection at work places and determination of aliphatic hydrocarbon fractions C1-C4 inclusive by the method of gas chromatography are presented, and selection of chromatographic column packing and optimum parameters for the substances in question are described. Separation of the hydrocarbons was best on a 3 m long column with a diameter of 4 mm which was packed with poly(diethylene glycol adipate) on alumina (26:100) at 25-30 C with nitrogen as the carrier gas. Gas-tight syringes were used for thy air sampling. The method was checked with mixtures containing mostly C2 and C3 hydrocarbons.

**33831** **APTIC NO. 56338**

Tokiwa, Y., SuzAnne Twiss, E. R. de Vera, and P. K. Mueller

ATMOSPHERIC OZONE DETERMINATION BY AMPEROMETRY AND COLORIMETRY. *In: Determination of Air Quality. Gleb Mamantov and W. D. Shults (eds.), New York-London, Plenum Press, 1972, p. 109-130. 18 refs. (Presented at the American Chemical Society Symposium on Determination of Air Quality, Los Angeles, Calif., April 1-2, 1971.)*

The magnitude of response to nitrogen dioxide interference was established for three oxidant analyzers, one amperometric unit using 2% potassium iodide and two colorimetric units using 10 and 20% KI. The two types of analyzers were compared side by side for 75 days of air monitoring data in an effort to examine and correct the results. The correlation between the two analyzers was not consistent throughout the oxidant concentration range, and the colorimetric unit read between 0.3 and 1.0 pphm higher even after correction for NO2. The observed differences were statistically significant, though the differences between the readings were considered to be within the precision of the analytical technique (plus or minus 1 pphm). Greater colorimetric response at low oxidant levels, where analyzer precision tends to be poorest, means that a small decrease in concentration would be registered by the colorimetric unit and not by the amperometric unit. Such variations at low levels would be proportionately larger with respect to the overall reading and would contribute adversely to the correlation between the two instruments.

**33832** **APTIC NO. 56337**

West, Philip W.

THE DETERMINATION OF TRACE METALS IN AIR. *In: Determination of Air Quality. Gleb Mamantov and W. D. Shults (eds.), New York- London, Plenum Press, 1972, p. 131-142. 15 refs. (Presented at the American Chemical Society Symposium on Determination of Air Quality, Los Angeles, Calif., April 1-2, 1971.)*

Procedures for two proposed complimentary analytical approaches, atomic absorption spectroscopy and the ring oven technique, which provide both reference and field application, are presented for atmospheric trace analysis of beryllium, cadmium, chromium, cobalt, copper, lead, nickel, and zinc. The ring oven technique provides a simple elegant method for the concentration of small amounts of material to permit increased sensitivity and quantification of spot reactions. By various schematic procedures, a variety of types of separations may be carried out on a single spot of sample unknown prior to final spot test identification and/or determination. The success of the ring oven approach depends on the reliability of the final colorimetric test reactions coupled with the conditioning steps required for the elimination of interferences. Errors in the quantitative measurements seldom exceed 20%, thus making the method comparable with other trace analysis techniques. The general design of the ring oven used is described and illustrated.

**33833** **APTIC NO. 56420**

Wilkins, Paul E.

FIELD USE OF IR SPECTROSCOPY FOR POLLUTANT DETECTION. *Anal. Instrum., vol. 10:2-6, 1972. 2 refs. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972.*

An infrared (IR) spectrometer was developed for the detection of pollutant gases. The instrument is of such size and weight and relative simplicity that it is applicable for field use. The instrument acquires a 1 cu in. sample of gas to be analyzed and compresses it into an optical chamber to a pressure of several atmospheres. The compression results in a heating of the gas causing emissions by the several IR active molecular species present in the sample. The instrument is capable of detecting several gas species simultaneously if the stimulated radiation is viewed through a series of windows in the optical chamber, each fitted with a filter to establish a spectral bandpass centered on an emission line of a gas of interest. The radiation passing the band filter is further processed by a pressure modulated gas cell before falling on a radiant energy detector. The compression cycle acts as the optical chopping mechanism and provides for synchronous detection of radiant energy changes between the two modulation pressure extremes. (Author abstract)

**33834** **APTIC NO. 56897**

Yudin, K. B.

COMBINED LOGARITHMIC AMPLIFIER AND CONVERTER FOR PHOTOELECTRIC PARTICLE COUNTERS. *(Logarifmicheskiy usilitel -preobrazovatel fotoelektricheskogo schetchika chastits). Text in Russian. Inst. Eksp. Meteorol., 2(36):121-124, 1972. 4 refs.*

The use of a logarithmic amplifier and converter for photoelectric aerosol particle counters operating on the principle of light scattering measurement is described. The transistorized logarithmic amplifier-converter combination is inserted between the photoelectric sensor and a standard multi-canal analyzer as for spectral analysis, and is designed to compress the input signal and to form the output pulse of the required front duration. Particle counters with logarithmic amplifiers and converters can be used for the measurement of high aerosol concentrations in general, and for the study of the microphysical properties of clouds and fog in particular.

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**33835** **APTIC NO. 56376**

Babst, R. W. and J. C. Goldsmith

DESCRIPTION AND APPLICATIONS OF A COMPUTER PROGRAM FOR THE INTERPRETATION OF RGA MASS SPECTRA. *Inst. Environmental Sciences, Mount Prospect, Ill., Proc. Inst. Environ. Sci., Annu. Tech. Meet., 17th, Los Angeles, Calif., 1971, p. 234-238. 3 refs. (April 26-30.)*

A computer program for the interpretation of a residual gas analyzer (RGA) was developed and applied to an air pollution monitoring system. A modified RGA replaces several analytical instruments presently required for measurement of the various pollutants. The remote RGA scans the air mixture when interrogated by the central control unit. The resulting mass spectrum is telemetered to a central time-shared computer processor. The output of the computer analysis is the concentration of each pollutant. The principal advantages of such a system are simplicity, ease of operation, and maintenance.

**33836** **APTIC NO. 56746**

Ball, D. F. and W. J. Orville-Thomas

THE IDENTIFICATION AND MEASUREMENT OF GASEOUS POLLUTANTS. *Preprint, National Society for Clean Air, Brighton (England), part 1, p. 3-26, part 2 p. 15-22, 1971. 13 refs. (Presented at th National Society for Clean Air Conference, Folkestone, England, Nov. 2-5, 1971.)*

The identification and measurement of gaseous pollutants by spectroscopic and chromatographic techniques are described. Gas analysis by infrared spectroscopy depends on the selective absorption of the infrared radiation by the gas. The characteristic absorption bands of carbon dioxide, water vapor, aldehydes, hydrogen bromide, carbon monoxide, nitric oxide, sulfur dioxide, ozone, ethylene, $COCl_2$, PAN, and acetylene are presented. Two infrared lasers which are most useful for pollutant detection are the $CO_2$ and iodine lasers. The remote Raman spectrometer has a major advantage in that the source and detector are on the same side of the atmospheric space to be measured, however, it cannot be operated in rain or fog. The polycyclic aromatic hydrocarbons have been analyzed by fluorescence spectroscopy. The nitrogen oxides and $SO_2$ can be determined by visible electron spectroscopy. Mass spectrometry (MS) has been used to analyze total hydrocarbons in exhaust fumes. When the technique is used in combination with gas chromatography (GC) the disadvantages of each, lack of recognition for GC and inability to analyze unseparated matter for MS, are overcome. A range of capital costs for the various instruments is presented.

**33837** **APTIC NO. 56652**

Caretto, L. S.

CHEMICAL ANALYSIS OF AIR POLLUTION SOURCES. *In: Combustion- Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 165-204. 53 refs.*

Instrumental techniques for the analysis of emissions from industrial and transportation sources are reviewed. Analysis of carbon monoxide and carbon dioxide is done almost exclusively by nondispersive infrared (NDIR) analysis since the technique allows for strong absorption of these gases in regions where there is little interference from other gases. The two most common instruments for measurement of total hydrocarbons are the flame ionization detector and hexane-sensitized NDIR; the latter, however, is not sensitive to olefinic hydrocarbons which are the main contributors to photochemical reactivity. Mass spectrometry has been used to separately measure nitric oxide and nitrogen dioxide, the two most common oxides of nitrogen found in exhaust streams; although for streams which contain only NO, NDIR is the best technique from the standpoint of ease, accuracy, and response time. Nondispersive ultraviolet analaysis can be used to measure NO2. Determination of oxygenated hydrocarbons involves collection of the compounds in an appropriate reagent for subsequent gravimetric, colorimetric, or chromatographic analysis. Analysis of sulfur dioxide can be achieved by NDIR if the sample is dried, while the use of dispersive spectroscopy has been proposed for the remote measurement of stack gas concentrations. Gas chromatography is generally the best method for overall analysis of emission constituents since it provides for separation of mixture components which can then be identified and quantitatively measured. The combination of gas chromatograph and mass spectrometer provides an especially powerful analytical tool for identification of almost all of the components in an exhaust gas stream.

**33838** **APTIC NO. 56650**

Mueller, Peter K.

DETECTION AND ANALYSIS OF ATMOSPHERIC POLLUTANTS. *In: Combustion- Generated Air Pollution. A Short Course on Conbustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 83-144. 85 refs.*

An annotated outline of the many complex aspects involved in the reliable assessment of air quality is presented. Considerations include: atmospheric composition, sample gathering and stability, analysis, and performance factors of air monitoring instrumentation. Reference is made to both gases and aerosols, including such constituents as sulfur dioxide, carbon monoxide, total hydrocarbons, oxides of nitrogen, oxidants, and ozone. Continuous air analysis methods are also reviewed, and features of various commercial continuous air analyzers are outlined.

**33839** **APTIC NO. 56280**

Owens, James C.

LASER APPLICATIONS IN METROLOGY AND GEODESY. *In: Laser Applications. Monte Ross (ed.), Vol. 1, New York, Academic Press, 1971, p. 61-131. 65 refs.*

Practical ways are presented on the use of spectral radiance of lasers as applied to meteorology and geodesy. Analyses are included for such topics as atmospheric refraction and dispersion, projected fringe patterns with compensated and uncompensated interferometers, and fluid velocities and turbulence. Velocity profiles and turbulence in fluid flow can be determined using focused bistatic systems, as in the measurement of wind tunnel flow and atmospheric wind. Practical systems normally operate with small scattering angles, in the range of 5-15 deg, especially if high velocities are to be measured. The Doppler shift is 2.75 kHz at an angle of 10 deg and a wavelength of 633 nm. The contribution of gross motion will be the same of all particles and Brownian motion will be the principal source of observed spectral width if the diameter of the scattering volume is small compared with the scale of turbulence of the medium and the sample averaging time is short compared with the characteristic time of the turbulence. An analysis in which typical values for natural aerosol and molecular number densities were used has shown that the optical Doppler method should be feasible for the measurement of wind velocity and turbulence in the open atmosphere.

**33840** **APTIC NO. 56422**

Rhodes, J. R., A. Pradzynski, R. D. Sieberg, and T. Furuta

APPLICATION OF A SI(LI) SPECTROMETER TO X-RAY EMISSION ANALYSIS OF THIN SPECIMENS. *In: Application of Low Energy X- and Gamma-Rays. C. A. Ziegler (ed.) Gordon and Breach, 1971, p. 317-334. 12 refs.*

The application of a silicon (lithium) spectrometer to x-ray emission analysis of thin specimens was investigated which included three samples of air pollution particulates. The samples were collected on a fiberglass filter paper, which is standard in air pollution monitoring, but not the best for x-ray fluorescence analysis because of its high blank, particularly in terms of zinc content. Typical spectra of a sample and a glass fiber filter blank are shown. The results of determination of calcium, iron, copper, lead, and bromine in the three samples of pollution particulates are given. The results show typical variations in total particulate loading, and Ca and Fe concentration that are reasonable in a limestone area. The Cu, Pb, and Br results are interesting. Lead and Br in an approximately 1:1 atomic ratio would be due solely to automobile exhausts. The high lead contents coupled with high Cu contents in two samples suggest the presence of another polluter such as an ore refinery or smelter.

**33841** **APTIC NO. 56347**

Robinson, G. D.

TURBIDITY MEASUREMENTS. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 27, p. 360-363. 8 refs.*

The turbidity coefficient is a measure of the extinction of solar radiation in the atmosphere. Measurement by standardized methods of a turbidity index such as with Volz photometers is probably the simplest soundest method of maintaining a continuous record in relative terms of the particulate load of the atmosphere. Other methods for determining the extinction of radiation by particles include: solar radiation records; aircraft measurements; satellite methods; searchlight and laser methods; and localized methods. There are two stations where reliable turbidity measurements have been made over a span of more than 50 years: Davos, Switzerland and Washington, D. C. Both show a secular increase in turbidity. Three are several well managed stations with 20 to 25 years of records, but most are in urban locations and reflect the trends of local urban pollution. The few aircraft, ground/satellite, and nephelometer type measurements show the potential importance of particulate absorption, but do not allow any generalized conclusions It may be advisable to supplement monitoring of the turbidity coefficient with extraterrestrial observations of the global albedo, in that the particulate loading of the atmosphere has an effect on the earth s albedo.

**33842** **APTIC NO. 56371**

Schotland, Richard M.

A DISCUSSION OF ERRORS IN THE LIDAR MEASUREMENT OF ATMOSPHERIC GASES BY MEANS OF DIFFERENTIAL ABSORPTION. *Preprint, Society for Applied Spectroscopy, Lewiston, N. Y., 22p., 1973. 28 refs. (Presented at the Society for Applied Spectroscopy National Meeting, 10th, St. Louis, Mo., Oct. 18-22, 1971.)*

An error analysis of the lidar measurement of the distribution of atmospheric gases by means of the differential absorption of scattered energy is applied to the measurement of the density of water vapor by a ruby lidar tuned to the 694.38 nm line of the vapor. The uncertainty in the measurement of water vapor is shown to be governed by instabilities in the laser frequency for observations below 2 km. The uncertainty in the measurement of the density at greater altitudes arises from the variance associated with the power measurement. The fractional standard deviation of the water vapor measurement is less than 6% for altitudes below 3 km. (Author abstract modified)

**33843** **APTIC NO. 56243**

Sekerdzi, Dimitar

UP-TO-DATE GAS CHROMATOGRAPHY AND ITS USE IN EXAMINATION OF EXHAUST GASES OF INTERNAL COMBUSTION ENGINES. *(Sodobna plinska kromatografija in njena uporaba pri raziaskavi izpusnih plinov zgorevalnih motorjev). Text in Slovenian. Nova Proizvod. Ljubljana, 22(1):5-10, 1971. 6 refs.*

Present day gas chromatographic methods and their use in the examination of exhaust gases from internal combustion engines are presented. Basic principles of the method are treated, and operation of instrumentation designed for exhaust gas analysis is described. A glossary of terms relevant to gas chromatographic techniques is also presented.

**33844** **APTIC NO. 56279**

Thompson, Brian J.

APPLICATIONS OF HOLOGRAPHY. *In: Laser Applications. Monte Ross (ed.), Vol. 1, New York, Academic Press, 1971, p. 1-60. 154 refs.*

A review of the applications of holography is presented. The majority of realized and suggested applications of the method involve visible light in both the recording and reconstruction of wavefronts. Nonimage-forming applications include interferometry, contour generation, and interference microscopy. Particle size analysis is one application of holographic image formation. A hologram camera (laser fog disdrometer) has been designed and fabricated as a customized instrumentation system for recording size and relative position of naturally occurring fog droplets in the 5-100 micron diameter size range. The system is based on a two step imaging technique using Fraunhofer holograms; consequently, the system is composed of two subsystems: the recording subsystem and the reconstructing subsystem. A short time laser pulse stops the motion of fog particles and instantaneously records the size and relative position of the particles in the sample volume. A system has also been designed for evaluation of highly dynamic aerosols. A modified off-axis reference beam method has been developed for measurement of larger particles of many hundreds of microns and upwards. The particles are demagnified prior to recording of the hologram, and the far field is then calculated from the demagnified image size. The technique could find important applications in such fields as raindrop sizing where sample volumes several meters in depth could be handled in a single exposure.

**33845** **APTIC NO. 56803**

Webb, R. J. and M. S. W. Webb

A RAPID EMISSION SPECTROGRAPHIC METHOD FOR THE ANALYSIS OF AIR FILTERS. *Atomic Energy Research Establishment, Harwell (England), Analytical Sciences Div., 11p., 1971. 7 refs.*

NTIS: AERE-R 6966

A rapid spectrographic method for the direct excitation of small portions of air filters has been developed and applied to the detection of such airborne contaminants as cadmium, lead, copper, nickel, manganese, iron, magnesium, vanadium, and boron. Preliminary experiments were conducted in which the sample paper was rolled up to form a cylinder and placed in a hollow graphited electrode. A condensed spark discharge in an atmosphere of oxygen was then used to burn the sample and excite the spectra. Small pieces of paper and ash were ejected during the process, and the incorporation of an internal standard became necessary to compensate for such losses. A piece of internal standard paper was placed beneath the sample paper and the two rolled together before being placed in the electrode since it was not feasible to impregnate the sample paper with a suitable internal standard solution. Photographic recording was used for interpretation of spectra, and line intensities were measured with a microphotometer when improved precision was required. Limits of detection varied from 0.1-1 microgram; and the results showed reasonable agreement with the more conventional technique of ashing the filter, mixing with a spectrographic buffer, and exciting in a d.c. arc.

**33846** **APTIC NO. 56884**

Zephoris, M.

AUTOMATIC DEVICE FOR THE MEASUREMENT OF ATMOSPHERIC SULFUR DIOXIDE. *(Realisation d un appareil automatique de dosage de l anhydride sulfureux dans l atmosphere). Text in French. Meteorologie, no. 20:13-33, Oct.-Dec. 1971. 7 refs.*

The iodimetric titration of sulfur dioxide is described. The apparatus is described. The device can handle from 50 to 2000 micrograms/cu m SO2. For SO2 concentrations of 500 micrograms/cu m, the titration result is almost linear when graphed. The curve inflects once more at 1500 micrograms/cu m, while the sensitivity is two to three times lower. The best results were obtained for concentrations of 40-400 micrograms/cu m. The influence of other pollutants on the reaction and improvements to the apparatus are described.

**33847** **APTIC NO. 56638**

Scott Research Labs., Inc., Redondo Beach, Calif., TRW Systems Group

EVALUATION OF INSTRUMENTS FOR VEHICLE EXHAUST EMISSION INSPECTION. (FINAL REPORT). *Coordinating Research Council, Inc., and Environmental Protection Agency Contract AK 727 SC, Proj. CRC-APRAC-CAPE-13-68, Rept. CRC-APRAC-CAPE-13-68-5, 58p., Aug. 1971.*

NTIS: PB 210016

Results of an instrumentation evalution program to determine the suitability of available commercial instruments for the measurement of vehicle exhaust emissions are presented. Seventeen automotive exhaust emission-measuring instruments were evaluated in terms of accuracy, repeatability, response time, cost, and several other parameters; carbon dioxide, carbon monoxide, hydrocarbons, and oxides of nitrogen were the pollutants of interest. The best instrument type for measuring carbon monoxide was found to be non-dispersive infrared, while flame ionization was the preferred method for hydrocarbons in automotive exhaust gas. Non-dispersive infrared was also found suitable for measuring carbon dioxide content. The instrument of choice for measurement of oxides of nitrogen was the fuel cell (electrochemical). A re-evaluation of instrumentation for performing analyses of automotive exhaust gases is recommended on a bi-annual basis. (Author abstract modified)

## 1970

**33848** **APTIC NO. 56716**

Brandon, John H.

MEASUREMENT OF PARTICULATE EMISSIONS. *Preprint, Industrial Coal Conderence, Purdue Univ. Layayette, Ind., 16p., 1970. (Presented at the Industrial Coal Conference, Lafayette, Ind., Oct. 7-8, 1970.)*

Principal test methods are reviewed for evaluating various factors which influence the amount and nature of particulate emissions contained in stack gases from boilers. The methods include: the Ringlemann technique for relating smoke color to density, representative sampling under isokinetic conditions, filter spot evaluation for light transmittance or reflection, and use of sampling trains involving the pitot tube. Better monitoring of stack discharges can be accomplished by use of the filter spot method as opposed to use of the color scale, although the system does not lend itself to isokinetic sampling, giving relative values only. Its most widespread application is in monitoring fallout of particulate alone area boundaries to ascertain the quanity of fallout. Most accurate testing is provided by a sampling train which consists of a Pitot tube, properly sized nozzle, heated glass-lined probe, double manometer, cyclone separator, glass fiber filter, impingers, absorbers, silica gel, heater control, ice bath, meter, and vacuum pump or aspirator. The Pitot tube is used initially to conduct a velocity traverse with the manometer. A Pitot tube and glass-lined heated probe can be connected together so that a continual reading of the velocity head in the stack and sampling can be obtained as the sample is being taken; for ease and quickness of operation, a monograph is used to determine the required sampling probe velocity head for a given stack velocity head.

**33849** **APTIC NO. 56744**

Chovin, P. and R. Gaudilliere

MEASUREMENT OF THE CONCENTRATION OF ATMOSPHERIC POLLUTION WITH EXHAUST GASES IN URBAN AREAS. *Air Conserv. (English translation from Polish of: Ochrona Powietrza), 4(6)(20):15-20, 1970.*

NTIS: TT 70-55124/6

Motor vehicle emissions are reviewed with particular reference to the measurement of carbon monoxide as an indicator substance in urban atmospheres. Ony method of CO measurement which indicates the maximal hazard to which pedestrians and drivers are subjected involves sampling at several sites by the filling of 2 l plastic bags with air. Once a month a delivery van collects four samples at each site; some 1300 pieces of data can be collected monthly. This method has been employed in the streets of Paris which was divided into 400 rectangles, and a map of air pollution concentrations in the city has been compiled along with the determination of the most dangerous zones. Another method which is more reliable but also more expensive can be used for indicating the mean actual hazard to persons remaining in the vicinity of the sample site for one hour s time. A plastic bag about 8 l in volume is filled for one hour at a constant delivery by means of a pump; the sample is then emptied via another pump at a higher delivery rate onto an infrared analyzer coupled to a recorder. The plastic bag is again filled with air sample and the cycle continues. This method of collecting average-per-hour samples provides for observing the changes in degree of pollution for the entire day and noting changes in traffic rate and weather conditions.

**33850** **APTIC NO. 56784**

Dravnieks, Andrew

ODORS: THEIR NATURE, MEASUREMENT, AND CONTROL. *Missouri Univ., Columbia, Coll. of Engineering and Missouri Air Conservation Commission, Jefferson City, Proc. Air Pollut. Conf. Contr. Dusts, Smokes, Noxious Odors, 3rd Annu., 1970, p. H-1 to H-15. 19 refs. (Nov. 17.)*

The category scale for odor intensity characterization is simple but has several shortcomings. More accurate odor intensity measurements can be obtained using odor intensity reference sets such as a diesel odor intensity kit based on a 12 bottle reference set of imitation diesel odors. Since odors of different quality can be consistently compared for intensity, considerable experience has been accumulated with an n-butanol reference scale. A psychophysical intensity function can be used to show the extent the odor intensity decreases with dilution by air. Thresholds are defined as concentrations at which the odor can be detected at some level of probability. But since individuals differ in sensitivity, much lower concentrations than the average threshold value will be noticed and complained about by a fraction of the population. Gas chromatography is presently the best analytical method for odor detection. Since each source emits components characteristic of the processes occurring in the source, emissions carry signatures of the particular sources. Odorants in effluents can thus be traced to their source. Odor quality can be characterized by several methods -- the profile method, attributes given semantically (preferably 15-30), or statistical mapping using seven to nine independent coordinates. Odors can also be scaled by pleasantness or unpleasantness attributes. Several devices for dilution and sampling of odors are described for an in-laboratory evaluation of in-field odors. Several odor control methods are mentioned.

**33851** **APTIC NO. 56728**

Hryniewizc, R. and L. Oliwa

DETERMINATION OF SULFATES IN ATMOSPHERIC DUST PRECIPITATION. *Air Conserv. (English translation from Polish of: Ochrona Powietrza), 4(6)(20):46-56, 1970. 6 refs.*

NTIS: TT 70-55124/6

A spectrophotometric method for the determination of 5-100 micrograms of sulfates per 1 ml sample of atmospheric dust precipitation is presented. Preparation of the sample involves passage of it over an ion exchanger (Amberlite IR 120) in order to avoid formation of complexes between cations within the sample and the thoron indicator used in the analysis. One ml of the sulfate solution is then made up to 15 ml with ethyl alcohol to which one drop of 5% perchloric acid is added; one ml of 0.05% aqueous thoron solution is added immediately before measurement. Contents are removed from the test tube to a 2 cm absorption cell of 30 ml capacity, and the measurement is started at 525 nm. Transmittance is set at 90%, and an air pump is switched on for mixing of the liquid in the absorption cell. A solution of barium perchlorate is then introduced portionwise (0.1 ml/min) with a microdosing pump into the alcohol absorption cell. Change in transmittance occurring after each addition is recorded as soon as the transmittance begins to decline. Five portions of barium perchlorate are subsequently added every minute, and each time the transmittance is noted. The transmittance is converted into terms of extinction, and a correction is introduced for dilution. The amount of barium perchlorate used for precipitating sulfate ions is plotted on a graph as a titration curve record. Titration of sulfuric acid is also performed with an established titer to determine the concentration of barium at each time. Accuracy of the method is within 20% for lowest concentrations and within 10% for dusts from a sample of 50 cu cm of air.

## 1968

**33852** **APTIC NO. 56791**

Fenimore, D. C., Albert Zlatkis, and W. E. Wentworth

LINEARIZATION OF ELECTRON CAPTURE DETECTOR RESPONSE BY ANALOG CONVERSION. *Anal. Chem., 40(10):1594-1596, Aug. 1968. 6 refs.*

An analog converter by which the amplified detector signal may be recorded as a linear function of sample concentration over an appreciably extended range has been devised to improve the accuracy and facility of electron capture quantitation. The converted signal can be displayed as a conventional chromatographic peak before integration and can also be recorded; if used with a digital integrator, the full dynamic range of the detector can be utilized without attenuation. The converter is operated by first applying a scale factor voltage of a magnitude such that the maximum converter output voltage will be of a convenient value for a given recorder sensitivity. Chromatographic peaks obtained from various concentrations of o-dichlorobenzene as normally displayed by electron capture detection are compared with converted responses of the identical sample concentrations; peak heights for the latter are quite linear with sample concentration, and the peaks assume the shape normally associated with linear response. The upper limit for the employment of the response converter is about 90% of detector saturation. The quantitative aspects of this approach should prove quite useful in the analysis of pesticides and electron capturing derivatives in biomedical analyses.

# AIR QUALITY MEASUREMENTS

## 1973

**33853** **APTIC NO. 56461**

Boss, Merlyn R., Farrel D. Hobbs, Robert W. Loser, and Donald E. Michels

ANNUAL ENVIRONMENTAL MONITORING REPORT: ROCKY FLATS PLANT, JANUARY THROUGH DECEMBER 1972, INCLUDING ESTIMATES OF RELEASES TO THE ENVIRONMENT FROM PLANT OPERATIONS. *In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites, Calendar Year 1972. Dow Chemical U.S.A., Golden Colorado, Rocky Flats Div., Atomic Energy Commission Contract AT(29-1)-1106, Rept. RFP-ENV-72, UC-11, p. 197-229, 1973. 9 refs.*

NTIS: WASH 1259

Results of an environmental monitoring program in the vicinity of a radioactive metal fabrication and chemical processing plant (Rocky Flats Plant, Jefferson County, Colorado) during 1972 are presented and indicate that yearly average environmental concentrations of plutonium in air and water were less than 2% of applicable Federal Standards. Total long-lived alpha emitter concentrations in air, including natural background, amounted to less than 30% of the soluble plutonium-239 standard. No apparent changes were noted in the distribution of plutonium in soil from previous years. Changes in the distribution isopleths compared with 1971 resulted from additional sample data in the computer modeling program and did not reflect physical movement of plutonium in soils. (Author summary modified)

**33854** **APTIC NO. 56466**

Bramson, P. E. and J. P. Corley

ENVIRONMENTAL SURVEILLANCE AT HANFORD FOR CY-1972 APPENDIX K. *In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites, Calendar Year 1972. Battelle Pacific Northwest Labs., Richland, Wash., Occupational and Environmental Safety Dept., Rept. BNWL-1727 ADD, UC-11, p. 1079- 1084, 1973.*

NTIS: WASH 1259

Environmental monitoring data for suspended particulates and nitrogen dioxide are presented as a supplement to the parent report for the Atomic Energy Commission s Hanford facilities, year 1972. Average concentration of suspended particulates in the air amounted to 174 micrograms/cu m, and average nitrogen dioxide concentrations for various locations ranged from 0.004 0.006 ppm.

**33855** **APTIC NO. 56397**

Corley, J. P.

AIR QUALITY. *In: Environmental surveillance at Hanford for CY-1970, Battelle Memorial Inst., Richland, Wash., Pacific Northwest Labs., p. 61-62, Sept. 1973. 1 ref.*

NTIS: BNWL-1669

The concentrations of nitrogen dioxide, sulfur dioxide, and suspended particulates were measured in the atmosphere at several off-site locations in the vicinity of Hanford during 1970. These data, reported in quarterly summary reports by the Hanford Environmental Health Foundation, are summarized. Nitrogen dioxide and SO2 samples were collected using 24-hour sequential samplers operated at ground level monitoring stations. The highest average NO2 concentration for any location was 0.007 ppm, 14% of the current Federal Air Quality Standards. All SO2 sample results were less than the detection level of 0.005 ppm, 20% of the Washington State Standard. Suspended particulates, measured at Richland, varied over a wide range due to heavy dust storms typical of the area. Measured fluctuations of NO2 and particulates were attributed to non-plant sources.

**33856** **APTIC NO. 56824**

Dodo, Hidenori

PRESENT SITUATION OF AIR POLLUTION IN HIROSHIMA PREFECTURE. *(Hiroshima-ken ni okeru taiki osen to sono eikyo. (A) Taiki osen no genjo). Text in Japanese. Hiroshima Igaku (J. Hiroshima Med. Assoc.), 26(7):114-117, July 1973. 3 refs.*

The air pollution levels of Otake, Kure, Fukuyama, and Hiroshima cities in Hiroshima prefecture were reported. Relative concentrations of sulfur dioxide in Otake, Kure, and Fukuyama determined by means of electroconductivity were almost half that in other polluted cities like Tokyo or Osaka. There were several heavily polluted places in those cities including Hiroshima cities, according to the measurement by the lead dioxide method. There was not a bad problem with particulates with a few exceptions in Kure city where the amount of the particulates exceeded the environmental standard (194.6 t/sq/km/mo versus 10 t/sq km/mo). The concentration of total suspended particulates were 23.7-297 micrograms/cu m in those cities during the period of 1971-1973, and several places had amounts over the environmental standard. Several places in the cities had amounts of carbon monoxide, nitrogen dioxide, and oxidants over the environmental standard. Although air pollution by automobile exhaust gas is increasing, there have not been serious problems yet.

**33857** **APTIC NO. 56463**

Emler, V. S. and S. H. Hullett

PORTSMOUTH GASEOUS DIFFUSION PLANT: ENVIRONMENTAL MONITORING REPORT -- 1972. *In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites Calendar Year 1972. Goodyear Atomic Corp., Piketon, Ohio, Atomic Energy Commission Contract AT-(33-2)-1, Rept. GAT-740, TR-021973-SAJ, p. 957-974, Feb. 28, 1973. 4 refs.*

NTIS: WASH 1259

Environmental monitoring data of both radioactive and nonradioactive pollutants are presented for the Portsmouth Gaseous Diffusion Plant located in Pike County, Ohio for the year 1972. The principal process in the plant is the separation of uranium isotopes through gaseous diffusion. Maximum concentrations of alpha and beta-gamma activity in the air were only 10.1 and 0.5%, respectively, of the applicable radioactivity concentration guides. Average ambient air concentrations for fluorides were no higher than 2.6 ppb. Annual average sulfur dioxide concentrations were all below the national secondary air quality standard, 60 micrograms/cu m. Concentrations for particulate matter ranged from 6.7-733 micrograms/cu m, and the annual geometric mean for the year was 145 micrograms/cu m. The particulate samples were collected only directly downwind from the steam plant; thus, the exceeding of the 60 micrograms/cu m standard was not surprising since it did not truly represent an average.

**33858** **APTIC NO. 56610**

Hernandez, F., A. San Miguel, P. Conillera, and M. Subira

STUDY OF SETTLING DUST COLLECTED IN BARCELONA. *(Etude de lapoussiere atmospherique recueillie par sedimentation a Barcelone). Text in French. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C85-C88.*

Results of chemical analyses of the soluble fractions of settling dust samples collected in Barcelona in October through December 1972 are presented. Dustfall was found to be highest in center city in densely populated areas of the city, and lowest in suburb-like sections. Dust samples from industrial sections were often either alkaline or acidic due to industrial emissions. The high chlorine, sodium, and potassium ion contents in the dust samples indicate the maritime character of the air in Barcelona. Dust samples from wooded, suburb-like sections featured high organic contents. The similarity in the course of the sulfate and calcium ion contents revealed that these components originate in emissions from building sites.

**33859** **APTIC NO. 56956**

Hirono, Tomio, Kunihiko Asakuno, Sekio, Izumikawa, Nobuo Ito, Masanao Funeshima, and Toshio Odaira

STUDY OF SOx, NOx STATE BY WATER SOLUBLE ION MEASUREMENT. *(Suiyosei ion ni yoru, SOx, NOx no seijo kaiseki). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):253, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 8.)*

Measurements of soluble ions (nitric acid ion and sulfuric acid ion) taken in the summers of 1971 and 1972 and in the winter of 1973 were compared, and the relationship between photochemical reactions and sulfur oxides and nitrogen oxides were examined. The measurements were obtained by high-volume sampler between 10 am and 4 pm, and 4 pm and 10 am. Nitric acid ion was analyzed by 2-4 xylenol colorimetry and sulfuric acid ion was analyzed by barium chloride turbidity. The measurements taken at the Tokyo high school where several photochemical incidents occurred were higher in winter in all categories of dusts, nitric acid ion, and sulfuric acid ion. However, when the ratio of nitric acid ion and nitrogen oxides, and sulfuric acid ion and SOx gas were compared, the measurements were higher in the summer. These measurements include water soluble ions created by photochemical reactions.

**33860** **APTIC NO. 56947**

Kaneko, Mikihiro, Yoshio Saiki, Shinichi, Nishiyama, Yasuji Himi, Shozo Fukui, Saburo Kanno, Toshio Koshimizu, Kazuyuki Takamatsu, and Yutaro Sekiguchi

THE CONCENTRATION OF CYANIDE IN AUTOMOBILE EXHAUST GAS, COMBUSTION STACK GAS, AND ENVIRONMENTAL AREA. *(Jidosha haishutsu gasu nensho haigasu oyobi seikatsu kankyochu ni okeru shian nodo). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):327, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 72.).*

Cyanide concentrations in solid waste incinerator stack gases, hot blast furnace flue gases, traffic intersections, and the environment of a coke furnace were measured. With automotive exhaust gases, cyanide concentration increased with increasing speed, ranging 6.5 mg/cu m at 40 kg/hr to 18 mg/cu m at 80 km/hr. The environmental standard for hydrogen cyanide is 11.6 mg/cu m. Catalytic converters were found effective in controlling cyanide concentrations in automotive emissions, and the elimination rate ranged from 50 to 80%. Incinerator stack gases contained 9.5-5.6 mg/cu m of cyanide when combustion was incomplete, and 1.2-0.2 mg/cu m when combustion was complete. No cyanide was detected in the flue gas of an ordinary hot blast furnace. The measurements taken at traffic intersections ranged from zero to 0.005 mg/cu m. Around coke furnaces, the measurements ranged from 0.006 to 0.009 mg cu m.

**33861** **APTIC NO. 56447**

Laxrus, A. L. and B. W. Gandrud

DISTRIBUTION OF STRATOSPHERIC SULFATE IN THE LOWER STRATOSPHERE. *In: Health Safety Lab. Fallout Program Quarterly Summary Report (June 1, 1973 through September 1, 1973), Atomic Energy Commission, New York, Health and Safety Lab., p. 1-19 to 1-26, 1973. 1 ref.*

NTIS: HASL-276

The distribution and stratospheric sulfate in the lower stratosphere was measured during the spring of 1972 across North and South America. The sulfate was analyzed on 1/3 portions of the airstream filters at the National Center for Atmospheric Research. The three measurements of stratospheric sulfate measured on combined opposite sixths of a filter are characterized by an average mean error of 2.2%. The sulfate concentrations are reported as mixing ratios, i.e., nanogram of sulfate/g of air sampled.

**33862** **APTIC NO. 56807**

Rahn, Kenneth, Marc Demuynck, Richard Dams, and Jean DeGraeve

THE CHEMICAL COMPOSITION OF THE AEROSOL OVER BELGIUM. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C81-C84. 15 refs.*

The amount and chemical composition of the aerosol over industrial, residential, rural, and background sites over Belgium is being monitored by a 14-station aerosol-sampling network. The total suspended particulate is determined by gravimetry on every sample, after which the filter is subdivided for analysis by fluorescence spectroscopy, turbidimetry, colorimetry, atomic absorption, and neutron activation. The filters from the 14 stations were analyzed for a day in October 1972 when the winds blew from SW-WSW. Useful data were obtained for 37 elements, sulfate, nitrate, and ammonium ions, and benzo(a)pyrene. The principal sources of the aerosol over Belgium are sea salt, weathered crustal material, combustion, and industrial emissions, although there is some independent evidence which suggests that natural sources are insignificant for practically all of the constituents measured. The average aerosol reported seems to represent a practically pure pollution aerosol.

**33863** **APTIC NO. 56876**

Sommer, M., F. Gouezo, J. Fondarai, and A. Viala

FLUCTUATIONS OF THE CARBON MONOXIDE CONCENTRATIONS IN A STREET IN MARSEILLE, AND MOTOR TRAFFIC CONDITIONS. A STATISTICAL STUDY. *(Fluctuations de la pollution oxycarbonee dans une rue de Marseille et conditions de circulation automobile - Etude statistique). Text in French. Pollut. Atmos. (Paris), no. 59:237-247, July-Sept. 1973. 4 refs.*

The effect of different traffic conditions on the carbon dioxide concentrations in a busy street in Marseille was studied by systematic measurement of the CO concentrations. The hourly maxima of the CO concentrations largely coincided with the maxima of the traffic density during rush hours. A reservation of the street for mass transportation vehicles led to a considerable reduction in the CO concentrations. Vehicles parked along the curb were found to constitute obstacles to the free dispersion of the exhaust emissions in general and of the CO in particular to the sidewalk. Freely moving one-way traffic was found to facilitate air exchange, and thus abatement of the CO concentration in the street.

**33864** **APTIC NO. 56448**

Volchok, H. L., L. Toonkel, and M. Schonberg

B. RADIONUCLIDES AND LEAD IN SURFACE AIR. *In: Appendix to Health Safety Lab. Fallout Program Quarterly Summary Report (June 1, 1973 through September 1, 1973). Atomic Energy Commission, New York, Health and Safety Lab., p. B-1 to 10, B-116 to B-123, 1973. 6 refs.*

NTIS: HASL-276

Data on stable lead concentration in surface air from 1966 to 1973 are presented. Samplers were placed on four Atlantic Ocean weather ships to obtain surface air measurements over the marine environment. Land measurements were made from about 70 deg North to 90 deg South. A list of the sampling stations along with their coordinates and elevations are included.

**33865** **APTIC NO. 56459**

Bendix Corp., Kansas City, Mo., Kansas City Div.

ENVIRONMENTAL MONITORING REPORT FOR REPORTING PERIOD 1-1-72 TO 12-31-72: THE BENDIX CORPORATION, KANSAS CITY DIVISION, KANSAS CITY, MISSOURI. *In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites Calendar Year 1972. Atomic Energy Commission Contract AT(29-1)-613 USAEC, UC-11, p. 1-37, 1973. 12 refs.*

NTIS: WASH 1259

Air and water pollution monitoring data are presented for the Bendix Kansas City plant, a non-nuclear weapon components manufacturer. Average and range of rates of emissions from each of two steam-generating boilerhouses are given for sulfur dioxide, nitrogen oxides, and particulates, while data from 22 six-hour composited samples are reported for ambient air concentrations of sulfur oxides (as sulfur dioxide), particulates, carbon monoxide, nitrogen oxides, and photochemical oxidants; hydrocarbon (non-methane) concentration data are included for six sampling tests. The data from the sampling indicate compliance with the applicable standards and relatively insignificant pollutant contribution cumulating from the facility with the possible exception of hydrocarbons. The ambient air concentrations of hydrocarbon pollutants both upwind and downwind of the plant indicate non-compliance with the national quality standard. Additional samples will be required to properly characterize ambient hydrocarbon levels in the vicinity of the plant. (Author summary modified)

**33866** **APTIC NO. 56462**

National Lead Co. of Ohio, Cincinnati, Ohio, Health and Safety Div.

FEED MATERIALS PRODUCTION CENTER: ENVIRONMENTAL MONITORING ANNUAL REPORT FOR 1972. *In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites, Calendar Year 1972. Rept. NLCO-1098, UC-11, p. 867-887, Feb. 16, 1973. 6 refs.*

NTIS: WASH 1259

Both radioactive and nonradioactive environmental monitoring data for the Feed Materials Production Center operated by the National Lead Co. of Ohio are presented for the year 1972. Primary work at the center is production of purified uranium metal and compounds for use at other Atomic Energy Commission sites, and the conversion of impure uranium and thorium compounds to reactor grade feed materials involves operations which generate radioactive dust, nuisance dusts, and corrosive mists or reaction products. Sampling of stack exhausts is maintained on a continuous basis. The data indicate that the average offsite concentrations of radioactive contaminants from the center's operations are less than 0.5% of the guide levels published in the Atomic Energy Commission Manual Chapter 0524. Average concentration of particulate matter exceeded the annual arithmetic mean set by the Ohio Environmental Protection Agency, while the average nitrogen dioxide concentration of all samples was 14.6% of the ambient standard annual arithmetic mean set by the State. Data for water and soil concentrations were also collected.

**33867** **APTIC NO. 56464**

Union Carbide Corp., Oak Ridge, Tenn., Nuclear Div.

ENVIRONMENTAL MONITORING REPORT: UNITED STATES ATOMIC ENERGY COMMISSION OAK RIDGE FACILITIES, CALENDAR YEAR 1972. *In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites, Calendar Year 1972. Rept. UCC-ND-244, p. 889-929, March 26, 1973. 9 refs.*

NTIS: WASH 1259

Environmental monitoring data are presented for the Atomic Energy Commission's Oak Ridge Reservation which includes facilities involved in nuclear research, the enrichment of uranium hexafluoride in the uranium-235 isotope, and weapon production and support activities consisting of the production and recovery of compounds and the fabrication of metal materials. Data on the concentrations of radioactive materials in air of the surrounding areas indicated an average gross beta radioactivity from particulates in the air of 0.08% of the applicable concentration guide specified in the AEC Manual, Appendix 0524. The average gross alpha concentrations were 0.13% or less than the concentration guide for natural uranium, and the average concentration of (131)iodine measured by a perimeter air monitoring system was less than 0.01% of the inhalation concentration guide for individuals in uncontrolled areas. Average concentrations for fluorides, reactive sulfur, dust fall, and suspended particulates did not exceed the applicable standards.

**33868** **APTIC NO. 56465**

Union Carbide Corp., Oak Ridge, Tenn., Nuclear Div.

ENVIRONMENTAL MONITORING REPORT: UNITED STATES ATOMIC ENERGY COMMISSION PADUCAH GASEOUS DIFFUSION PLANT, CALENDAR YEAR 1972. *In: Environmental Monitoring At Major U. S. Atomic Energy Commission Contractor Sites, Calendar Year 1972. Rept. UCC-ND-245, UC11, p. 931-955, 1973. 6 refs.*

NTIS: WASH 1259

Environmental monitoring data are presented for the Paducah Gaseous Diffusion Plant located in McCracken County, Kentucky for the year 1972. The plant is engaged in operations involving uranium enrichment cascade with associated uranium hexafluoride manufacturing. Air analyses for alpha and beta radioactivity averaged less than 1% of the applicable Radioactivity Concentration Guide for all off-site sampling stations. Air and grass off-site analyses for fluorides met the Kentucky air quality requirements. Data was also collected for water and soil samples.

**33869** **APTIC NO. 56821**

Ministry of International Trade and Industry (Japan) and Kogawa Prefectural Government (Japan)

A REPORT OF A COMPREHENSIVE PRE-INVESTIGATION OF INDUSTRIAL POLLUTION IN SAKAIDE AND MARUKAME AREAS. *(Sakaide, Marukame-chiki sangyo kogai sogo jizen chosa hokokusho). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 9(10):1024-1033, Oct. 1973.*

Air pollution in 1975 in Sakaide and Marukame was estimated using area weather information, wind tunnel diffusion tests, and diffusion models. Factories using more than 200 l/hr of fuel were studied. Control programs will reduce the amount of pollution and make the sulfur oxide standard achievable.

## 1972

**33870** **APTIC NO. 56258**

Syrota, J.

CHAPTER III: THE RESULTS OF AIR POLLUTION MEASUREMENTS. *(Chapitre III: Les resultats des mesures de la pollution atmospherique). Text in French. Pollut. Atmos. (Paris), no. special:35-71, July 1972.*

Sulfur dioxide, black smoke, dust fallout, carbon monoxide, nitrogen oxides are studied in terms of geography and seasonal variations on a comparative basis within and outside France. Emisison intensities and atmospheric dispersibility are also examined. The highest average pollution levels have been recorded in large cities, and particularly in Paris, where pollution by sulfur dioxide and dust particles has been diminished because of improved and controlled combustion by the use of less polluting fuels instead of coal. The levels attained for sul-

**fur oxides (0.118 mg/cu m) in 1969-1970 were lower than those in many foreign large cities. Carbon monoxide pollution (15 ppm in 1970) has been decreasing since 1967 (27 ppm). Carbon monoxide pollution still seems higher than in most foreign large cities. Data and tables are presented for comparative statistical examination.**

**33871** **APTIC NO. 56456**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION III: OBSERVED POLLUTANT CONCENTRATION LEVELS. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 74-84. 5 refs.*

The observed pollutant concentration levels in Great Britain are tabulated. There was a decrease in all regions from 1962 through 1969 for both smoke and sulfur dioxide levels, though the levels and rates vary widely from region to region. The annual average levels for SO2 for the whole country have fallen by about 35% over the yr 1957-1967. Emissions have fallen for domestic sources by 25%, but have increased for industrial sources by 25%, while total emission have increased by 9%. The generally higher levels of pollutants in the regions of the Midland and further north, as compared with the south, is probably due to the higher domestic coal consumption per head of population in these regions. In country and rural areas the available evidence on average pollutant levels is more scanty and more restricted in time than for urban areas. The available data from motor vehicles is confined largely to smoke, SO2, carbon monoxide, and lead, ranging over a very short period of time. The odors arising from industrial plants, brick works, power plants, sewage works, pig farms, and other agricultural sources are also a significant local problem which can not be measured by instruments.

## 1971

**33872** **APTIC NO. 56302**

Craxford, S. R., M-L. P. M. Weatherley, and B. D. Gooriah

THE NATIONAL SURVEY OF SMOKE AND SULPHUR DIOXIDE. THE FIRST TEN YEARS. *Preprint, National Society for Clean Air, Brighton, England, part 1, p. 114-124, part 2, p. 41-50, 1971. (Presented at the National Society for Clean Air Conference, Folkestone, England, Nov. 2-5, 1971.)*

The first 10 years of the British national survey of smoke and sulfur dioxide are summarized. The survey included 1100 towns and 2000 country sites. There was a dramatic decrease in smoke concentration over the United Kingdom as a whole since 1960. Except for Wales and London, the average smoke concentration decreased from North to South in parallel with the decrease in domestic coal consumption per head. The coal burned in Wales produced less smoke than other areas. The average concentration of smoke in London was rather high, 45 micrograms/cu m due to the high population density. The smokiest site were north of the Midlands. There was a 28% decrease from 1960 in sulfur dioxide emissions across the United Kingdom. Regionally, London had as high an average SO2 concentrations as the industrial north. The average concentration of SO2 for urban areas was about twice that of smoke. The highest acceptable concentration for a combination of smoke and SO2 was 500 micrograms/cu m. This concentration was exceeded often in London, the Midland, and the North.

**33873** **APTIC NO. 56445**

Mammarella, L., A. Biondi, M. Colacino, A. Guerrini, and F. M. Vivona

THE COURSE OF ATMOSPHERIC URBAN POLLUTION. *(Andamento dell inquinamento atmosferico urbano). Text in Italian. Consiglio Nazionale della Ricerche, Rome (Italy), Istituto di Fisica dell Atmosfera, TR-35, 118p., Feb. 1971. 37 refs.*

**An experimental study with the aid of aerosol differential samplers to ascertain the state of air pollution due to traffic in an urban residential area of Rome during a fall and winter period. The bi-seasonal study permitted differentiation between traffic and home heating pollution. A concomitant factor is the almost constant presence of weak air currents at regular intervals, which far from alleviating the pollution, tend to diffuse and expand it uniformly throughout the area, despite the abundance of green spaces. Both a more ample and rapid promulgation of regulations for domestic combustion control and the application of auto pollution control norms are recommended.**

**33874** **APTIC NO. 56529**

Yanagisawa, Saburo

A REPORT OF INVESTIGATION ON ACTUAL CONDITIONS OF AIR POLLUTION IN AND AROUND TOKYO AND OSAKA INTERNATIONAL AIRPORTS. *(Tokyo oyobi Osaka kokusaikuko shuhen ni okeru taiki osen jittai chosa hokokusho). Text in Japanese. 86p., June 1971.*

**Air pollution in Osaka and Tokyo airports was measured, including carbon monoxide, total hydrocarbon, and nitrogen oxide concentrations. Aircraft engine exhausts were measured at Tokyo airport. The concentration of CO around the airports was low; the effect of aircraft was not evident. The concentration of hydrocarbons (as methane) was 3.0 ppm on the average at Tokyo and 2.3 ppm at Osaka. The average NOx concentration was 0.091 ppm, slight pollution; the effect of aircraft was not clear. Engine exhaust particulates contained 44% silicon, 35% aluminum, 8.8% benzene-soluble substances, and 1.2% iron.**

**33875** **APTIC NO. 56275**

California Air Resources Board

CALIFORNIA AIR QUALITY DATA JUNE, JULY, AUGUST 1971. *Preprint, 53p., 1971.*

Detailed information on the quality of the ambient air over California cities for June, July, and August 1971 is tabulated. The contaminants measured were oxidants, carbon monoxide, sulfur dioxide, nitric oxide, nitrogen dioxide, total oxides of nitrogen, total hydrocarbons, and suspended particulate. Included are the maximum hourly average concentration for each day, the highest of these values for the month, the monthly average of these values, and the peak concentration reached during the month. Tables presenting values for the daily average and highest reported reading for particulate matter by the AISI method and 24-hour values for particulate matter by the high volume filter method are included. Also shown are tables defining values equalling or exceeding the State ambient air quality standards for oxidant, CO, NO2, and suspended particulate. Maximum hourly oxidant concentrations above .08 ppm were reported by 40 stations in five air basins on June 15. One of the least smoggy days was June 10. Maximum temperatures on the high oxidant day were some 17 F higher than maximum temperature on the low oxidant day.

**33876** **APTIC NO. 56276**

California Air Resources Board

CALIFORNIA AIR QUALITY DATA FOR SEPTEMBER THRU DECEMBER 1971. *Preprint, 59p., 1971.*

Detailed information on the quality of the ambient air over California cities for September through December 1971 is tabulated. The contaminants measured were oxidants, carbon monoxide, sulfur dioxide, nitric oxide, nitrogen dioxide, total oxides of nitrogen, total hydrocarbons, and suspended particulates. Included are the maximum hourly average concentration for each day, the highest of these values for the month, the monthly average of these values, and the peak concentration reached during the month. Tables presenting values for the daily average and highest reported reading for particulate matter by the AISI method and 24-hour values for particulate matter by the high volume filter method are included. Also shown are tables defining values equaling or exceeding the State ambient air quality standards for oxidant, CO, NO2, and suspended particulate. Pollutant concentrations were lower on the permissive control burn days despite the relatively widespread agriculatural burning. There was an improvement in air quality on Oct. 14-15 due to more favorable meteorological conditions.

**33877** **APTIC NO. 56277**

California Air Resources Board

CALIFORNIA AIR QUALITY DATA FOR MARCH, APRIL AND MAY, 1971. *Preprint, 39p., 1971.*

Detailed information on the quality of the ambient air over California cities for March, April, and May 1971 is tabulated. The contaminants measured were oxidants, carbon monoxide, sulfur dioxide, nitric oxide, nitrogen dioxide, total oxides of nitrogen, total hydrocarbons, and suspended particulate. Included are the maximum hourly average concentration for each day, the highest of these values for the month, the monthly average of these values, and the peak concentration reached during the month. Tables presenting values for the daily average and highest reported reading for particulate matter by the AISI method and 24-hour values for particulate matter by the high volume filter method are included. Also shown are tables defining values equaling or exceeding the State ambient air quality standards for oxidant, CO, NO2, and suspended particulate. Oxidant levels equaling or exceeding the Federal standard of 0.08 ppm were reported by 52 stations out of 70 in March, 47 in April, and 42 in May. Only one station reported more than 10 hr of equaling or exceeding the nitrogen dioxide state standard for 1 hr. A summary of the hi-vol data for suspended particulate matter is arranged by basin on a statewide basis; 14.6% of the data exceeded the State standard of 100 micrograms/cu m.

**33878** **APTIC NO. 56278**

California Air Resources Board

CALIFORNIA AIR QUALITY DATA FOR DECEMBER 1970, JANUARY AND FEBRUARY 1971. *Preprint, 32p., 1971.*

Detailed information on the quality of the ambient air over California cities for Dec. 1970 and Jan. and Feb. 1971 is tabulated. The contaminants measured were oxidants, carbon monoxide, sulfur dioxide, nitric oxide, nitrogen dioxide, total oxides of nitrogen, total hydrocarbons, and suspended particulate. Included are the maximum hourly average concentration for each day, the highest of these values for the month, the monthly average of these values, and the peak concentration reached during the month. Tables presenting values for the daily average and highest reported reading for particulate matter by the AISI method and 24-hour values for particulate matter by the high volume filter method are included. Also shown are tables defining values equaling or exceeding the State ambient air quality standards for oxidant, CO, NO2, and suspended particulate. Lower than normal temperatures and higher than normal wind speeds helped keep pollutants down in December. There was a period of elevated oxidant readings in the South Coast and San Diego basins during the last half of January due to above average temperatures. Nitrogen oxide was also high during that period. The warm spell continued into the first two weeks of February, and elevated pollutant levels were found.

**33879** **APTIC NO. 56792**

Environmental Protection Agency, Research Triangle Park, N. C., Air Pollution Control Office

MOUNT STORM, WEST VIRGINIA-GORMAN, MARYLAND, AND LUKE, MARYLAND-KEYSER, WEST VIRGINIA, AIR POLLUTION ABATEMENT ACTIVITY. (PRE-CONFERENCE INVESTIGATIONS). *APTD-0656, 133p., April 1971. 63 refs.*

An air pollution investigation was conducted in the Mt. Storm, W. Va.-Gorman, Md., and Luke, Md.-Keyser, W. Va. areas in 1969 and 1970. The major problem in the Mt. Storm-Gorman area is air pollution related damage to commercial Christmas tree growing operations. Air quality measurements were made for sulfur dioxide, nitrogen dioxides, oxidants, particulate matter, and fluorides. A review of the vegetation damage (discoloration, browning of needles, tip burns, poor foliage) suggest that SO2, ozone, and settling particulates are of primary concern. The major sources of SO2 and particulate matter are the Mt. Storm Power Plant and the Westvaco pulp mill. There are three power plants outside the area that could have an appreciable affect on air quality. The relatively high O3 source is not established. The air pollution problems in the Luke and Keyser area are caused by particulate matter and noxious sulfur gases released from industrial plants. A pulp and paper mill operated by the Westvaco Corp. is the primary source of air pollutants. A control program will not be achieved until 1975 or 1976. A number of smaller sources include a coal washing plant, a charcoal plant, and a gob pile. Additional information for both areas include: history of problem, Federal abatement activity, geography, climatology, and air pollution meteorology.

## ATMOSPHERIC INTERACTION

### 1973

**33880** **APTIC NO. 56715**

Adam, J. R., R. Cataneo, D. F. Gatz, and R. G. Semonin

STUDY OF RAINOUT OF RADIOACTIVITY IN ILLINOS. *Illinois Univ., Urbana, Ill., Illinois State Water Survey, Atomic Energy Contract AT(11-1)-1199, Rept. COO-1199-30, 171p., May 1973. 55 refs.*

A description is presented of a field project designed to determine the effects of an urban area (St. Louis) on the precipitaton process. Unique chemical tracers released into the updrafts of convective clouds were used to obtain insight into the scavenging mechanism of the treated clouds. Observed scavenging values ranged from about 150 for lead to about 1280 for magnesium No significant upwind/downwind differences were found for the scavenging ratios, although concentrations in both precipitation and air showed variations ranging up to about tenfold. Little or no relationship was found between scavenging ratios and any of the several meteorological or particle parameters examined, including atmospheric stability, rainfall amount, synoptic rain type, and solubility of aerosol materials in the rain. There also appeared to be no distinct correlation between the precipitation and the pH and likewise between the areal pH pattern and the industrial areas of the St. Louis metropolitan region. Concentrations of particulate matter in the St. Louis area were significantly above rural levels and were detectable at a distance of the least 25 miles.

**33881** **APTIC NO. 56787**

Anspaugh, L. R., P. L. Phelps, N. C. Kennedy, and H. G. Booth

WIND-DRIVEN REDISTRIBUTION OF SURFACE-DEPOSITED RADIOACTIVITY. *Preprint, Inst. of Automotive Engineers of America; Air Advisory Committee, North European Group; and World Health Organization, 28p., May 11, 1973. 15 refs. (Presented at the Symposium on Environmental Behavior of Radionuclides Released in Nuclear Industry, Aix-en-Provence, France, May 14-18, 1973.)*

Wind-driven redistribution of surface-deposited radioactivity was studied in relation to (239)Plutonium, one of the radionuclides generally regarded as constituting an inhalation hazard through wind-driven resuspension. Suspended particle concentrations in the air over the Atomic Energy Commission s Nevada Test Site were examined over a period of six weeks following the nuclear cratering event, Project Schooner, and over a 10-month period following accidental venting of an underground nuclear explosion. Suspended air activity was observed to decrease in time with half-times of 35-80 days; this factor appeared to be much more important than variations in meteorological parameters over these relatively short time periods. Movement of small particles in suspension accounted for only a minor fraction of the total mass movement, and as much as 50% of the initially deposited debris was moved by saltation within a 24-hour period. Such movement can result in extensive microinhomogeneities with accumulation of debris under bushes or in other places affording shelter from erosive forces. A more detailed study of the resuspension process in an aged (239)Pu field is currently in progress. Preliminary data are given for the particle size distribution of the total mass and the (239)Pu moving in suspension. (Author abstract modified)

**33882** **APTIC NO. 56400**

Carr, Roderick A. and Peter E. Wilkniss

MERCURY IN THE GREENLAND ICE SHEET: FURTHER DATA. *Preprint, U. S. Naval Research Lab., Washington, D. C., 2p., 1973. 8 refs.*

New data support the contention that the mercury content of Greenland glacial ices has not increased dramatically in recent years, but rather is distributed non-homogeneously through the ice sheet. Ice core samples from Camp Century (77 deg 10 min N, 61 deg 08 min W) and Site 2 (76 deg 59 min N, 56 deg 04 min W) were analyzed by flameless atomic absorption. A distinct difference appears between the mercury content of the two sites, lending support to Dickson s contention that the distribution of Hg through the ice cap is not homogeneous. (Author abstract modified)

**33883** **APTIC NO. 56512**

Egan, Bruce A. and Thomas F. Lavery

APPLICATIONS OF A NUMERICAL SIMULATION MODEL TO THE DISPERSION OF VEHICULAR EMISSIONS NEAR HIGHWAYS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B7-B9. 6 refs.*

The dispersion of air pollutants emitted from vehicles on various roadways has been successfully predicted using a two-dimensional numerical simulation model in which emitted material is in effect transported numerically through a vertical grid in a series of time steps until a steady state concentration distribution is achieved. Horizontal and vertical wind speed values and vertical diffusion coefficients, specified at each point in the grid, control the transport of the material; and the wind and diffusivity fields are calculated as a function of the roadway design configuration, the nature of structures in the vicinity of the roadway, and meteorological conditions. These winds and diffusivities parameterize such effects as turbulent eddies on the lee side of obstructions. The model was applied to the problem of the dispersion of carbon monoxide emitted from vehicles on roadways in Washington, D. C., while field observations of CO were obtained for validation and calibration. The overall agreements between observed and predicted values was quite good over nearly three orders of magnitude of the range of values.

**33884** **APTIC NO. 56435**

Gatz, Donald F.

TRACE ELEMENT CHEMISTRY STUDIES. *Illinois State Water Survey, Atmospheric Sciences Section, Dept. of the Interior Contract 14-06-D-7197, Technical Rept. 7, 12p., June 1973. 9 refs.*

Background silver in Illinois precipitation was measured in the absence of any known seeding operations in or near Illinois. The overall rainfall weighted mean concentration at several stations was 73 ng/l. This is somewhat higher than has been found in unseeded precipitation in the Western United States, but probably not high enough to preclude identification of silver iodide seeded precipitation, especially if the more sensitive element ratio method is used. (Author abstract modified)

**33885** **APTIC NO. 56449**

Gifford, F. A.

THE SIMPLE ATDL URBAN AIR POLLUTION MODEL. *Preprint, North Atlantic Treaty Organization Committee on the Challenges of Modern Society, Brussels (Belgium), 18p., 1973. 16 refs. (Presented at the Meeting of the NATO/CCMS Panel on Modeling, 4th, May 30, 1973.) (ATDL Contribution File No. 78 Revised.)*

The development and the application of a simple urban air pollution model in use at the Atmospheric Turbulence and Diffusion Laboratory in Oak Ridge is described. The area source model involves an integration in the upwind direction of a cross wind infinite line source diffusion formula. The equation was calibrated by means of annual air pollution data from 44 U. S. cities and the constnat C determined to average approximately 225 for nonreacting pollutants. Comparisons of the equation with various more detailed pollution models show that it is a consistently better predictor of long-term air pollution patterns. The model has also been compared with annual particle pollution mean values, with annual and seasonal sulfur dioxide and particle pollution patterns with short-term pollution patterns down to 1 hr, with time varying carbon monoxide pollution patterns up to 48 hr, and with photochemical pollution.

**33886** **APTIC NO. 56570**

Hales, Jeremy M., M. Terry Dana, and Marvin A. Wolf

ADVANCES IN THE THEORY AND MODELING OF POLLUTANT-GAS WASHOUT. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B92-B93. 5 refs.*

A model for predicting scavenging of sulfur dioxide from plumes under generalized meteorological conditions has been developed with the aid of field observations at a large, coal-fired power plant. The observed relationship between SO2 washout and pH indicated that solubility is an important factor in determining washout behavior of this material and implied that the washout does not occur irreversibly but rather in a reversible fashion that allows the raindrops to outgas SO2 as they fall below the more concentrated portions of the plume. Such postulated behavior is consistent with the observation of low SO2 scavenging rates from high plumes and the relatively high importance of low-altitude background SO2 in determining the washout distributions. It is also consistent with the observed dependences on acidity. The postulates were tested by performing an analysis of reversible scavenging, and two additional field experiments were designed to test the validity of the reversible theory and to determine its applicability to analyzing washout from industrial plumes. The washout measurements from these tests exhibited well-behaved distributions and generally agreed with reversible model predictions. Subsequent application of the reversible model to the original site has given encouraging results.

**33887** **APTIC NO. 56382**

Hanna, Steven R.

APPLICATION OF A SIMPLE DISPERSION MODEL TO A RURAL INDUSTRIAL REGION. *Preprint, 15p., 1973. 10 refs. (Presented at the Industrial Air Pollution Control Conference, Annual, 3rd, Knoxville, Tenn., March 29-30, 1973.)*

A simple dispersion model for multiple point and area sources was applied to the Rockwood-Harriman, Tenn. region. It contains two small towns and two major industries. Predicted annual average suspended particle concentrations are well correlated (r equals .95) with observations at four stations. Variations in daily average concentrations at the four stations are partly accounted for (r is approximately .5) by variations in daily average wind speed. (Author abstract)

**33888** **APTIC NO. 56442**

Hanna, Steven R.

URBAN AIR POLLUTION MODELS--WHY? Preprint, 20p., 1973. 13 refs. (Presented at Nordic Symposium on Urban Air Pollution Modeling, Vedgaek, Denmark, Oct. 3-5, 1973.)

The usefulness of urban air pollution models is discussed and the comparison of a simple and a complex model used to predict carbon monoxide concentrations in Los Angeles is presented. Current urban dispersion models are either simple or complex and are used for the simulation of spatial and temporal variation of urban air pollution concentrations and for understanding of physical and chemical processes occurring in urban air pollution. In a comparison of a simple and a complex model used to measure CO concentration, there was no significant difference between the ability of the two models to correctly simulate hour-to-hour variations in concentrations. The simple and complex models were each better at four different stations. The average correlation for the complex was .63 compared to .61 for the simple model. The complex model is used as the diffusion model for a model of photochemical smog, and thus the simple model would be useful as a diffusion model.

**33889** **APTIC NO. 56458**

Huff, Floyd A. (ed.)

SUMMARY REPORT OF METROMEX STUDIES, 1971-1972. *Illinois State Water Survey, Urbana, Investigation 74, ISWS-73-R174, 173p., 1973. 59 refs.*

A summary is presented from analyses of two years of data collected in the five-year Metromex field program, a large-scale investigation of inadvertent weather modification in an urban area of St. Louis. The two-year results provide evidence that rain, thunderstorms, and hail maximize at locations 10-15 miles downwind of the urban-industrial region; these locations had more storms that were more intense, lasted longer, and produced greater amounts of rain and hail. The results also show that an atmosphere modified by heat and various particulate emissions in the urban area moves up to levels where it can affect clouds and that the urban-modified atmosphere acts to invigorate convective storms and to increase the efficiency of precipitation events. Preliminary results from experiments designed to examine the scavenging of sub-micron particles by precipitation and convective cloud processes indicate that under favorable conditions an urban-industrial aerosol can be processed by precipitating convective storms and deposited in the region of observed climatic rainfall maximum downwind of the city. (Author abstract modified)

**33890** **APTIC NO. 56630**

Idso, S. B.

THERMAL RADIATION FROM A TROPOSPHERIC DUST SUSPENSION. *Nature, (London), 241(5390):448-449, Feb. 16, 1973. 16 refs.*

An example of the interaction of atmospheric aerosol with longwave terrestrial radiation is reported. A huge, but weak, dust storm hit Phoenix, Arizona on July 29, 1972. The following day was cloudlness and atmospheric radiation measurements were collected. The results were compared with measurements on three other cloudless days, screen level air temperature, vapor pressure, wind speed, and visibility. Using the Brunt equation to estimate the effects on the atmospheric thermal radiation of the reduced air temperature, but increased vapor pressure of July 30 compared to the other three cloudless days, it was calculated the energy flux should have been 1.6% greater on July 30. The actual measurements were 5.9% greater, implying the the dust suspension of July 30 was responsible for the 4.3% increase in atmospheric thermal radiation.

**33891** **APTIC NO. 56534**

Kemeny, Etel

SMOKE AND SULPHUR DIOXIDE MEASUREMENTS AS A REFLECTION OF THE ATMOSPHERIC CONDITIONS OVER SOUTH AFRICA. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B36-B38. 4 refs.*

Smoke and sulfur dioxide concentrations, using April as a reference month (first month without significant precipitation), are presented for various towns in South Africa and are related to atmospheric conditions. The data indicate that increases and decreases in the concentrations from month to month in the towns of Pretoria, Germiston, and Bloemfontein are not so much due to changes in emission but rather to changes in atmospheric conditions. Indication is also given that in Pretoria, where the smoke concentration increases by 2.1 times the April concentration, the atmosphere is less able to disperse the pollutants than is the atmosphere over Germiston or Bloemfontein where the concentrations increase 1.8 fold only. Johannesburg is more favorable with concentrations increasing only 1.6 fold. Cape Town s atmosphere is the most favorable; concentrations increase 1.1 fold in the center and 1.3 fold in the industrial area. Wind data recorded by the South African weather stations indicate that Pretoria has the lowest wind speeds and the highest frequency of calms of all towns where smoke and SO2 are currently being measured. Concentrations of smoke and SO2 increase in all towns except Cape Town because the ventilation power of the atmosphere decreases.

**33892** **APTIC NO. 56667**

Kranz, William T. and David P. Hoult

DESIGN MANUAL FOR TALL STACKS. *Massachusetts Inst. of Tech., Cambridge, Mass., Fluid Mechanics Lab., FML-Pub-73-3, 85p., April 1973. 21 refs.*

A method for calculating the ground level concentration of pollutants emitted from a chimney in excess of 100 m in height is described. The method incorporates the recent developments in plume aerodynamics and atmospheric mixing of chimney plumes. Pollutant dispersion is strongly dependent on atmospheric turbulence. In this model, mechanically generated turbulence is ignored compared to thermally generated turbulence. During the day, this normally occurs at altitudes in excess of 100 m. Since the thermal turbulence is caused by solar energy, a discussion of the solar heat flux (insolation) is included. The recently developed models for estimating atmospheric turbulence and its effect on pollutant dispersion are presented. The plume rise phenomena is described in fluid dynamic terms. The plume rise is calculated in terms of measurable atmospheric variables: wind speed, lapse rate, and solar heat flux. The plume rise solutions are only valid for buoyant plumes which require that the chimney have a large heat flux. The graphic solution technique for determining the ground level concentration of pollutants emitted from a tall stack is presented. Dats sources and estimation procedures for the necessary meteorological data are included. Plume rise and ground level concentrations should be estimated with the aid of a computer.

**33893** **APTIC NO. 56602**

Legrand, Michael

CLIMATOLOGIC MODEL OF SULFUR OXIDES-GENERATED AIR POLLUTION. *(Modele climatologique de la pollution de l air par les oxydes de soufre). Text in French. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B27-B30. 6 refs.*

**A climatologic model of sulfur oxides air pollution is described which is suitable for the evaluation of the consequences of the extension of industrial and residential zones, for the estimation of the contribution by a group of emission sources to the background pollution, for the determination of the optimum site and the minimum height of new stacks, and for the optimization of the number and siting of air pollution monitoring stations Meteorologic parameters such as wind speed and direction, a factor describing the diffusive capacity of the atmosphere, the vertical temperature gradient, the air temperature, as well as the emission parameters are the input data of the model. An empiric formula describing the turbulent diffusion of the pollutants in the atmosphere, adopting the Gaussian representation of the spatial distribution of the pollutant concentrations for point and extended sources, as well as a statistic model based on the hypothesis of log normal concentration distribution in a given point are the basic components of the model. With the knowledge of the frequency of the occurrence of a given meteorologic situation, the probability of pollution levels lower than a given value was determined. The application of this model to the sulfur oxides pollution in the Anvers area permitted the determination of the site of the median of the concentration distribution, and the percentage of the contribution by residential and industrial sources to the background concentration.**

**33894** **APTIC NO. 56325**

Levine, Howard B.

SUBSONIC JET AIRCRAFT CONTRIBUTION TO NOX IN THE STRATOSPHERIC OZONE LAYER: 1968 TO 1990. *Preprint, American Inst. of Aeronautics and Astronautics, N. Y. and American Meteorological Society, Boston, Mass., 5p., 1973. 8 refs. (Presented at the American Institute of Aeronautics and Astronautics/American Meteorological Society International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-534.)*

The contribution of subsonic jet aircraft to nitrogen oxides in the stratospheric ozone layer from 1968 to 1990 is discussed. Part of the exhaust emissions from subsonic jet aircraft flying above the tropopause reach the stratospheric O3 layer by eddy diffusion. Source strengths can be estimated from current data and future projections of air travel utilization. A simple atmospheric model allows estimation of the resulting NOx concentrations in the O3 layer. Comparison of such calculations with similar ones for an SST fleet show that by 1990 the NOx concentration due to subsonic jets will be less than that estimated for the SST fleet only by factors of five to 20. (Author abstract modified)

**33895** **APTIC NO. 56600**

Loewenstein, J. C.

THE SEPARATE INFLUENCE OF CLIMATE AND POLLUTANT EMISSIONS ON THE EVOLUTION OF THE DAILY SULFUR DIOXIDE AND SMOKE LEVELS IN THE PARIS URBAN AGGLOMERATION IN THE 1962-1972 PERIOD. *(Influence separe du climat et des emissions de polluants sur l evolution des taux quotidiens d acidite et de fumees dans l agglomeration parisienne entre 1962 and 1972). Text in French. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B79-B84. 2 refs.*

Acid (sulfur dioxide) and black smoke concentrations monitored in the Paris urban agglomeration at 30 sampling stations during the 1962-1972 period were analyzed to derive relationships between the SO2 and black smoke levels, the climatic conditions, and the SO2 and smoke emissions. Largely identical seasonal variations in the SO2 and smoke levels, with the maxima in January, and the minim in August, was determined. The pollutant levels were much higher under anticyclonal conditions than during atmospheric perturbations. The changes in the SO2 and smoke levels as determined as a function of meteorological conditions were similar. The coincidence of large emissions with unfavorable meteorological conditions always led to high pollutant levels. The increase in the smoke emissions and the 20% decrease of SO2 emissions during the last years of the investigation period are affected by the sulfur content of the fuels used, by the share of coal within the total amount of the fuels used, and by the condition of the firing equipment.

**33896** **APTIC NO. 56949**

Longhetto, A.

TURBULENT DIFFUSION OF AIR POLLUTANTS. *(Diffusione turbolenta di inquinanti nell atmosfera). Text in Italian. G. Fis., vol. 14:140-159, April-June, 1973.*

A discussion of general mathematic theories of air turbulence focusing on the atmospheric dispersion of pollution is presented. The natural state of air movement of atmospheric fluid can consist of a simple mean motion over which one of secondary vorticose is superimposed. This secondary motion has an extremely complicated, non-periodic, oscillatory character. The origin, development, and decay of this state are controlled not only by surface irregularities and cinematic characteristics of the flux, but also by gravitational effects due to vertical variations in density. This last derives from daily variations of surface temperatures provoked by contrasting effects of solar radiation. Situations in which turbulence is highly developed are called lapses vis-a-vis periods of inversion. The fundamental parameter which regulates air turbulence is the Richardson number, representing the relationship between hydrostatic energy of the fluid and the cinetic energy of the vortexes. Approaches to the diffusion problem can be grouped according to the gradient, static and similarity theories. The first is based on the premise that local rate of material transport due to turbulence is proportional to the local gradient; the second is based on the work by Sutton (1923) and Taylor, and consists of establishing a form the correlation function between turbulence velocity observed at instances separated by intervals; and the third approach implies that the static properties of the movement of a point of fluid can remain similar to themselves in all parts of the turbulent fluid. The mathematical function which described these properties can differ among themselves from point to point in the flux only by a scaler factor.

**33897** **APTIC NO. 56712**

Mattis, Robert P. and Lyndon R. Babcock, Jr.

RELATIONSHIPS BETWEEN METEOROLOGICAL AND AMBIENT-AIR-QUALITY PARAMETERS: ESTIMATION OF UNMEASURED POLLUTANT LEVELS. *Preprint, American Institute of Chemical Engineers, 22p., 1973. 18 refs. (Presented at the American Institute of Chemical Engineers, National Meeting, 74th, New Orleans, La., March 14, 1973.)*

The relationships between meteorological and ambient air quality parameters were investigated by a multiple regression analyses of readily available data from Chicago, Ill. and Washington, D. C. during 1968. Pollutants included in the regression were carbon monoxide, nitric oxide, nitrogen dioxide, sulfur dioxide, total hydrocarbons, total oxidants, and soiling index (particulate matter). Temperature variables yielded the highest correlations with individual pollutants, while wind had a small number of meaningful correlations. No meaningful paired relationships were identified for the precipitation variables except dewpoint, nor with one exception, for the solar radiation variables. The pollutant to pollutant relationships were less apparent for Chicago; the expected particulate/SO2 relationship was high in both cities. The ORAQI method of pollutant estimation predicts a high level of an unmeasured pollutant when the measured pollutant levels are high.

**33898** **APTIC NO. 56518**

Mazzeo, Nicolas, Matilde Nicolini, Leonardo Moledo, and Carlos H. Muller

LARGE-SCALE ESTIMATION OF VERTICAL DISPERSION EFFICIENCY OF THE ATMOSPHERE IN THE ARGENTINE REPUBLIC. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B53-B58. 3 refs.*

Monthly average heights of maximum vertical mixing based on monthly averages of temperature at different heights and monthly mean daily maximum surface temperatures were computed for the Argentine Republic in order to achieve partial estimation of conditions that mainly dominate the vertical dilution of contaminants; isolines of the dispersion parameter were also drawn on maps of the Republic. The results were concluded as useful for estimating the diurnal large-scale vertical maximum dispersion, and comparison of the maps permitted the distinguishing of zones with relatively reduced vertical mixing from those with deeper heights of vertical mixing. The extreme values of monthly average height of maximum vertical mixing calculated were 3210 m at Neuquen (January) and 560 m at Rio Gallegos (July). It will be necessary to complete the information of the present study with maps containing isolines of transport wind in the vertical mixing layer in order to estimate large-scale atmospheric dispersion conditions over the whole country. Isoline maps for each of the 12 months and a topographical map of the Republic with radiosonde stations used are depicted.

**33899** **APTIC NO. 56535**

Merino, M. Martinez, M. Teresa de Pedro, F. Moya Morales, and F. Escudero Gil

MATHEMATICAL MODEL FOR AIR POLLUTION FORECASTING. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B59-B65. 5 refs.*

An empirical type air pollution forecasting model for establishing a quantitative relationship between meteorological and emission factors and the ground level concentrations of pollutants has been specifically established for the city of Madrid, Spain. Ground level concentrations were determined by analysis of sulfur dioxide and suspended particulate matter in 24-hour samples, while emission sources were empirically estimated. A general equation for pollution dependence was established which incorporates pollutant emissions and the meteorological parameters humidity, temperature, pressure, and wind velocity. Regression analysis was performed to minimize the error function relating the experimental with the calculated data. Values of calculated and measured pollution for the year 1969 are shown, as well as errors expressed as fractions of unity with their respective signs. The number of predicted values obtained with errors of less than 20% with respect to measured values was 146 out of a possible 273; only 17 of the values exceeded a 50% error.

**33900** **APTIC NO. 56817**

Mizoguchi, Tsugio

AIR POLLUTION CONTROL SYSTEM. *(Taiki osen seigyo shisutemu ni tsuite). Text in Japanese. Shisutemu to Seigyo (Syst. Control), 17(3):134-142, March 1973. 36 refs*

A computer system for environmental monitoring is described. Air quality forecasting, diffusion models, and statistical models are discussed. The combination of industrial and automotive sources, meteorology, and topographic interactions causes a complex situation in urban areas.

**33901** **APTIC NO. 56601**

Orieux, Adrien, Jean Achard, Emile Pouget, Jean Paul Cano, Jacques Catalin, Alain Viala, and Jacques Covo

THE INFLUENCE OF METEOROLOGICAL FACTORS ON THE DIFFUSION OF SULFUR DIOXIDE AND NITROGEN OXIDES IN THE FOS-L ETANG DE BERRE REGION. *(Influence des facteurs meteorologiques sur la diffusion du dioxyde de soufre et des oxydes d azote sur la zone de Fos-l Etang de Berre). Text in French. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B39-B42. 11 refs.*

The influence of meteorological factors on the diffusion of sulfur dioxide, nitrogen dioxide, and nitric oxide was analyzed on the basis of SO2 measurements performed according to the Bodeker method and of NO2 and NO measurements according to the Saltzman method in the Fos-l Etang de Berre region in 1972. At the same time, wind directions, speeds, and air temperatures in the lower layer of the atmosphere were also recorded. Both the SO2 and nitrogen oxide concentrations were found to be relatively low, and the NO to NO2 ratio was determined to be below 1. The concentration peak, observed one day between 9 am and 11 am was due to very low wind speed and the occurrence of temperature inversion being in the course of dissolution. The subsequent increase of the wind speed to over 4 m/sec, and that of the dynamic turbulence, as well as the development of nearly adiabatic thermal conditions in connection with that of massive vertical pollutant transport finally led to a drop in the pollution level.

**33902** **APTIC NO. 56563**

Ottar, B

THE LONG RANGE TRANSPORT OF AIR POLLUTANTS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B102-B104. 3 refs.*

The first phase of a project to study the long range transport of air pollutants over the Scandinavian countries and Europe has resulted in an emission survey, compilation of ground station and airplane sampling data, development of an atmospheric dispersion model for north-western Europe, and forecast of air pollution situations due to long range transport. Highest pollution levels in Scandinavia have been obtained when a high pressure situation with inversions and low winds cause an accumulation of the pollutants in the source area; such situations, with markedly acid precipitation and highly polluted air, have occurred 20-30 times a year and with equal probability at any season. Total amount of sulfate to come down in the southern part of Norway during the first half of 1972 was 50,000 tons with an acidity of 70%; in comparison, the total emission of sulfur dioxide from Norwegian sources was 17,000 tons in this region. Acid precipitation in the Scandinavian area appears to be highly dependent on orographic effects, and similar effects are suspected for other parts of Europe. Considerable amounts of sulfuric acid and other pollutants are transported from the central industrial areas in Europe to Scandinavia, and analysis of several precipitation periods has shown that both eastern and western Europe contribute to this pollution.

**33903** **APTIC NO. 56533**

Palmieri, Sabino, Ernesto Migliardi, and Gianfranco Simonini

METEOROLOGICAL FACTORS AND THE DISPERSION OF ATMOSPHERIC POLLUTANTS PRODUCED BY INDUSTRIAL SOURCES LOCATED IN MOUNTAIN AREAS AND ALONG THE COASTS. *Proc. Int Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p B10-B12. 3 refs.*

Preliminatry considerations are presented based on data confined to local wind circulation and to stability conditions in the lower atmosphere over industrial sites located in coastal and mountain areas of the Italian peninsula. The intensities of local circulation were nearly the same for mountain and coastal areas, whereas the radius of the wind rotation in the coastal sites appeared to be much greater (double) than over mountains. There was a strong tendency over the mountains, starting at the release height of 40 m, for instability cases to pass into the class of neutral lapse rate, while at the height of 120 m instability was no longer present. A similar behavior was noticed for the coastal sites. Additionally, there was a definite increase of neutral cases with height over the mountain, while the same cannot be said for the Po valley site examined. This difference appears due to the fact that the wind speed becomes closer to that corresponding to free atmosphere at the same level when the height is sufficient to be free from the effects of friction retardation and sheltering.

**33904** **APTIC NO. 56596**

Polster, Gebhard

ANALYSIS OF WEAK VERTICAL EXCHANGE AND SMOG CONDITIONS. *(Analyse austaucharmer Wetterlagen und Smoglagen). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B75-B78. 7 refs.*

A method for the quantitative analysis of weak atmospheric exchange conditions occurring during smog periods is described. Long-period measurements of the aerosol activity in the air near the surface show that the main effects which cause high concentrations during weak vertical exchange conditions are the low height of the high-level inversion and the low intensity of the turbulence in the sublayer of the inversion. From balloon and vector-vane measurements a concept was developed to obtain height-profiles of the vertical diffusion coefficients. Vertical averages of these profiles were used to estimate the increase of concentrations according to the theory developed by Bouman and Schmidt. The points of the vector-vane measurements were plotted on a diagram containing the four basic types of turbulence according to Jacobi. A height profile of the lower 50 m is then plotted, and the 50 m point is connected with the height profile at 120 m, and the high inversion sublayer is extrapolated from balloon measurements. From this height profile, a vertical mean is calculated.

**33905** **APTIC NO. 56424**

Reck, R. A.

INFLUENCE OF SURFACE ALBEDO ON THE CHANGE IN THE ATMOSPHERIC RADIATION BALANCE DUE TO AEROSOLS. *General Motors Corp., Warren, Mich., Research Labs., Res. Pub-GMR-1397, 26p., May 21, 1973. 22 refs.*

The influence of surface albedo on the change in the atmospheric radiation balance due to aerosols was investigated. An initial value radiative convective atmospheric model shows that atmospheric aerosols can produce either heating or cooling, depending on the surface albedo. The model, a modification of that of Manabe, Strickler, and Weatherald, consists of nine points vertically and includes effects of carbon dioxide, water, ozone, low lying aerosols, and three layers of clouds. Both solar and terrestrial fluxes were calculated. Absolute humidity was assumed to be constant. For input parameters characteristic of 35 deg N latitude in April and surface short wave albedos, omega s, of 0.07 and 0.3, the model predicts cooling due to aerosols. However, when omega s is increased to 0.6, heating is predicted. A plot of surface temperature change, delta Ts, versus the mean aerosol extinction coefficient in the visible/km, sigma vis prime (for omega s equals 0.3) has a minimum at sigma vis is approximately equal to 3. Similar plots for omega s equals 0.07 and 0.6 show a leveling off of delta Ts with increasing sigma vis. (Author abstract modified)

**33906** **APTIC NO. 56595**

Sadelski, Mieczyslaw

STUDY OF CORRELATION BETWEEN CALCULATED AND MEASURED SO2 DISPERSION IN A HIGHLY INDUSTRIALIZED AREA. *(Untersuchung ueber die Zusammenhaenge zwischen Ausbreitungsrechung und messung der SO2-Immission in einem stark industrialisierten Gabiet). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B31.*

Correlation between calculated and measured sulfur dioxide concentrations at different distances from a total of 196 major emission sources in a 50 km radius in a highly industrialized area in Poland was studied. A mathematic model adopting Sutton s formula for the dispersion calculations was used. The yearly average SO2 concentrations, and the frequency of concentration values exceeding a given yearly concentration were determined by computer. The calculated values showed good correlation with SO2 concentrations measured by means of the suction technique at 20-minute averages, and those determined by the absorption method using lead oxide. Considerable contribution to the measured SO2 concentrations by non-industrial SO2 emissions was also discovered.

**33907** **APTIC NO. 56485**

Sinclair, Peter C.

THE LOWER STRUCTURE OF DUST DEVILS. *J. Atmospheric Sci., 30(8):1599-1619, Nov. 1973. 26 refs.*

Measurements from an extensive field program in the desert near Tuscon, Ariz., were used to formulate a quantitative dust devil model. The model is based on measurements of temperature, pressure, and wind velocity taken from a mobile instrumental tower near and within dust devils at levels of 6, 17, and 30 ft. Three dust devil profiles established the existence of the warm, low pressure core of the dust devil. Maximum temperature and pressure variations within the dust devil varied from 4-8 C and 2.5-4.5 mb. The most significant result was a downcurrent or a region of markedly reduced vertical motion along and surrounding the sloping dust devil axis. Immediately outside the downcurrent, the vertical velocity reached positive peak values and then diminished rapidly with respect to increasing radius. Superimposed on this motion was a strong rotary and radial motion which resulted in a combined flow pattern similar to that of a helical vortex. The measurements were synthesized into a dust devil model. The observational model represents a two-cell structure which also appears to exist in other atmospheric vortices. (Author abstract modified)

**33908** **APTIC NO. 56747**

Thuillier, Richard H.

A REGIONAL AIR POLLUTION MODELING SYSTEM FOR PRACTICAL APPLICATION IN LAND USE PLANNING STUDIES. *Preprint, Bay Area Air Pollution Control District, San Francisco, Calif., 25p., 1973. 3 refs.*

A regional, climatological, Gaussian dispersion model was developed and coupled with a statistical concentration frequency estimation model for practical application in land use planning studies in the Bay area. The dispersion model was split into two separate submodels: a regional, low resolution submodel and a local high resolution submodel. The complete model was designed to yield the following information on a resolution of 1 sq km: the annual arithmetic mean concentration for each contaminant; the number of times per year in excess of standards; and the portion of the problem derived from local sources vs. the portion due to import. Use of a climatological model on an area averaged basis has the effect of smoothing or averaging out the large random error fluctuations inherent in short term, point by point modeling applications. Residual error in the climatological model (which can with care be reduced to 20% or less of the true climatological average) is amenable to further reduction through tuning, if a long term record of contaminant and meteorological data is available. The same data record may be used as the basis for a statistical recovery of spatial and temproal detail lost in the climatological smoothing process. The output is a modeled probability distribution of contaminant concentrations which is a function of local and regional climatology and any assumed geographical distribution of emissions. The form of the output is quite useful for planning and design applications.

**33909** **APTIC NO. 56536**

Ukeguchi, Nobuhiro, Hiroki Okamoto, and Yasuo Ide

PREDICTIONS OF CALM-INVERSION POLLUTION. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. B66-B68. 8 refs.*

A mathematical model for estimating pollutant concentrations during calm-inversion conditions is presented. A series of equations is developed from which the expression for the ultimate maximum concentration that should occur at the origin in a half unbounded atmosphere for a sufficiently long elapse of time is derived. The equations show that the ground concentration of calm-inversion pollution (CIP) is inversely proportional to source height, suggesting that CIP prevention might be equally well met by emission reduction as by increasing stack height and/or plume rise. Ground concentration increases with elapse time and finally approximates the ultimate value in the case of an inversionless atmosphere, though it never approximates to the fixed value and only continues to increase with time in the case of a bounded atmosphere. Increase rate of concentration with elapse time appears to depend upon source height as well as vertical diffusivity, as the source from a lower height contributes earlier to the increase in ground concentration. An inversion factor which may become larger and larger with increasing elapse time is defined to make clear the effect of capping inversion.

**33910** **APTIC NO. 56495**

Saitama Prefectural Government (Japan), Social Welfare Div.

REPORT ON A THREE DIMENSIONAL EXAMINATION OF PHOTOCHEMICAL SMOG IN THE SUMMER OF 1972. *(Showa 47 nendo kaki ni okeru kokagaku sumoggu rittai chosa hokohusho). Text in Japanese. 54p., Jan. 1973.*

Photochemical smog in Japan was measured from July 18 to Aug. 17, 1972. Oxidants, ozone, winds, temperature, and nitrogen oxides were measured at ground level and in the lower atmosphere. When a typical wind from the sea came to Saitama Prefecture, the wind from the south blew at ground level and then rose to 1000 m; then the inversion layer formed. The ozone concentration was constant from the ground to 1000 m. For 4 days with high oxidant concentrations, the atmospheric pressure gradient was small, the wind blew from the south and was weak in the morning, the sunshine was bright, and the inversion layer formed in the morning. Polluted air from Tokyo came within 3 hours. The correlation between the oxidant concentration and the wind at 100 m was strong.

**33911** **APTIC NO. 56663**

California Univ., Livermore, Lawrence Radiation Lab.

PROGRAM REPORT - FY 1973: ATMOSPHERIC SCIENCES GROUP, PHYSICS DEPARTMENT, LAWRENCE LIVERMORE LABORATORY. *Atomic Energy Commission Contract W-7405-Eng-48, TID-4500, UC-11, 18p., Aug. 28, 1973, 53 refs.*

NTIS: UCRL-51444

A series of air pollution projects under the direction of the Atmospheric Sciences Group at the Livermore Laboratory are described. The projects cover a wide spectrum of studies based primarily on numerical analyses of atmospheric processes. Five distinct modeling efforts are underway: dispersion and transport model, global kinetics and transport model, zonal atmospheric model, stratospheric kinetics model, and radiation transport model. The models treat the diffusion and transport of aircraft exhaust emissions and the photochemical reactions of these pollutants with ozone and other components of the ambient atmosphere, focusing on the mechanisms and results of possible modifications in the composition of the stratosphere. From these calculations, induced changes in the global climate and ultraviolet radiation at the earth's surface will be investigated. A regional model of the transport and diffusion of nonreactive air pollutants for the San Francisco Bay Region was developed and used to study the dispersion of carbon monoxide.

## 1972

**33912** **APTIC NO. 56750**

Albert, Richard E., Harry Moses, and William Robinson

SOME MEASUREMENTS OF NOCTURNAL WIND FLOW OVER ST. LOUIS: METROMEX 1971. *In: Radiological and Environmental Research Division Annual Report. Atmospheric Physics. January through December 1972. Argonne National Lab., Argonne, Ill., p. 1-19, 1972. 3 refs.*

NTIS: ANL-7960, Part IV

An important consideration in the development of mesoscale pollutant dispersion models is the fact that systematic differences in mean wind distributions exist over urban and rural terrain, caused by the physical and thermal structure of the cities themselves. This disturbed wind flow above a large metropolitan area was studied in the summer of 1971 as a contribution to the Metropolitan Meteorological Experiment. A network of pilot-balloon launching stations was operated in and near St. Louis, Mo. to obtain measurements of representative wind flow over the central urban, suburb, and rural areas. Wind profiles, wind variability as denoted by ranges of wind speed and direction, and diurnal and vertical variations were studied. A low level jet, generally at 200-300 m, appeared during all six nighttime periods. On five of the six nights, the maximum speeds over the city occurred 100 m higher than in the country; on the sixth night, August 17, with the lightest winds, the rural maximum occurred at 300 m, but no real urban peak occurred. The wind speeds at 100 m in the rural area exceeded those over the city, but a crossover in speed profile occurred between 200 and 700 m. Wind direction was affected by pressure and urban-rural circulation patterns. Wind variability was greater over the city than over rural areas. The city influenced variability up to at least 1000 m. Average direction range values at all levels were 30 deg over the city, compared with 10 deg for the rural area. However, urban direction ranges decreased with height to about 20 deg at 800 m, while rural ranges remained low at all levels. Wind variability varied inversely with wind speed. Also, wind speed ranges were minimum at the level of the low level jet maximum.

**33913** **APTIC NO. 56385**

Bushtuyeva, K. A., M. D. Manita, and S. A. Akhmedova

ON APPROACHES TO THE STANDARDIZATION OF OZONE IN THE AIR OF RESIDENTIAL AREAS. *(O podkhodakh k normirovaniyu ozona v atmosfernom vozdukhe naselennykh mest). Text in Russian. Gigiena i Sanit., 37(5):6-9, 1972. 12 refs.*

Problems of the interactions of ozone with other air pollutants are discussed with respect to the standardization of maximum allowable atmospheric ozone concentrations in the air of residential areas. Actual ozone, hydrocarbon, and nitrogen oxide concentration measurements performed in Baku and Ali-Baymarli are evaluated. The primary reaction involved in the photochemical smog formation is the decomposition of nitrogen dioxide into nitric oxide plus native oxygen under the action of ultraviolet radiation. The joint oxidation of hydrocarbons and nitrogen oxides results in the formation of products that form peroxyacyl nitrates and peroxybenzoyl nitrates of highly oxidative nature. With the absence of hydrocarbons in the atmosphere, dynamic equilibrium conditions with stable NO, $NO_2$, oxygen and ozone concentrations are established. The specific interactions of $O_3$ with other air pollutants make it senseless to establish maximum allowable concentrations for ozone without taking the consequences of its presence in the atmosphere into account. Ozone concentration measurements performed in Baku and Ali-Baymarli with elevated HC and $NO_2$ concentrations revealed regularity in the ratio of the oxidant and ozone concentrations. The differences in the coefficients determined for the individual sampling sites were, with two exceptions, statistically significant. The coefficient truly reflects the concentration levels of the initial products and oxidants, but not those of O3. The coefficients of the oxidant-ozone ratios as established for five sampling sites were 9.3, 8.7, 8.4, 5.0, and 2.5.

**33914** **APTIC NO. 56780**

Daw, F. A. and K. J. O Loughlin

CANBERRA, A.C.T. - DISPERSION CLIMATOLOGY AND METEOROLOGICAL EFFECTS ON THE DISTRIBUTION OF AIR POLLUTION. *Clean Air Society of Australia and New Zealand, Proc. Int. Clean Air Conf., Melbourne, Australia, 1972, p. 39-46. 7 refs. (May 15-18.)*

Field measurements were taken in the winter and autumn of 1971 at specific sites in Canberra and analyzed and collated with other data in an effort to examine the dispersion meteorology of the city with particular reference to factors which contribute to the potential of the locale for air pollution. The city is at an elevation of 1900 ft near the northern end of a valley with few exits; and the topography and geographical position, some 60 miles from Australia s east coast and within the sub-tropical high pressure belt, combine to establish a poor dispersion climate. Poor dispersion winds occur on approximately 45% of the days in autumn and early winter but have a frequency less than 30% in late winter and spring. Data taken from the top of Black Mountain and records made simultaneously at the airport meteorological office indicate an overall stable surface layer frequency between 65 and 75%. The strength of low level inversions as indicated by vehicle ascents was typically around 3 C and those indicated by radiosonde flights were typically around 5 C. Average subsidence inversion frequency was 0.25, though of the 89 inversion days considered, only 26 inversions had a duration of less than two days. Maximum mixing heights from a small sample of only 8 days were in the range of 1000 to 1700 m. Low ventilation (less than 2000 sq m/sec in the morning and less than 6000 sq m/sec in the afternoon) occurred on the 16th and 17th of August and probably on the two preceding days as well.

**33915** **APTIC NO. 56386**

Fortak, Heinz

POSSIBLE APPLICATIONS OF MATHEMATIC-METEOROLOGICAL DIFFUSION MODELS TO THE SOLUTION OF CLEAN AIR MAINTENANCE PROBLEMS. *(Anwendungsmoeglichkeiten von mathematisch-meteorologischen Diffusionsmodellen zur Loesung von Fragen der Luftreinhaltung). Text in German. Minister fuer Arbeit, Gesundheit und Soziales des Landes Nordrhein-Westfalen, Duesseldorf, West Germany, 52p., 1972. 38 refs.*

Possibilities and problems of mathematical-meteorological diffusion models in air pollution control are described. It is possible to technically and economically optimize the most important air pollution control measures, i.e., monitoring systems and planning, by the use of mathematical-meteorological diffusion models within input-output systems. The mathematical-meteorological simulation of emission and transmission processes, as well as of ground level concentrations is complicated by a great number of influencing factors, such as temperature, temperature stratification, wind speed and direction, radiation, precipitation, turbulence, sedimentation, washout, topography, orography, and photochemical and other physicochemical reactions occurring between air pollutants and other constituents of the air during pollutant dispersion. Notwithstanding all these influences, there are now models for the pollution climatology of point source areas and for entire cities and regions. Minimum stack heights, and even planned changes in the pollution climatology such as may be due to improvements in technological processes and to additional pollution sources, can be now predetermined by means of such models. Detailed description is given of the pollution survey and pollution modeling conducted in the Bremen area. The development of time-dependent pollution prediction models, and of methods for the optimization of pollution control and planning measures are among the latest trends in the area of mathematical-meteorological models.

**33916** **APTIC NO. 56754**

Frenzen, Paul and Richard L. Hart

ATMOSPHERIC DISPERSION OVER WATER INFERRED FROM TURBULENCE STATISTICS. *In: Radiological and Environmental Research Division Annual Report. Atmospheric Physics. January through December 1972. Argonne National Lab., Argonne, Ill., p. 74-83, 1972. 12 refs.*

NTIS: ANL-7960, Part IV

The reduced dispersion of atmospheric pollutants over water was studied experimentally. Observations were obtained from a tower 1.6 km from the eastern shore of Lake Michigan. Fluctuations in wind speed and direction were measured and used to determine turbulent velocity fluctuations. Lateral wind fluctuations over extensive water surfaces tended to be symmetrically distributed about their longer term mean values. Estimates of plume dispersion over open water were obtained from the measurements through the empirical expression developed by Islitzer for an elevated source. The variation in the root mean square horizontal wind direction fluctuations with stability was computed. Comparative plume dimensions were predicted for slightly stable, neutral, slightly unstable, and significantly unstable conditions 1 km downwind of a point source by the Pasquill nomograms for smooth and rough land. Under stable conditions, dispersion over open water is similar to that over smooth grasslands in comparably steady mean winds. Once stratification of the lower atmosphere crosses neutrality and becomes unstable, lateral dispersion rates over both smooth and rough land increase rapidly, while that over open water lags behind. Dispersion in similar instabilities over land more than doubles the plume widths observed in neutral conditions.

**33917** **APTIC NO. 56900**

Garger, Ye. K., T. N. Zhigalovskaya, V. V. Yegorov, N. M. Kireyeva, B. M. Matkovskiy, and A. I. Shilina

ON BACKGROUND LEVELS OF CERTAIN TRACE ELEMENTS IN FRONTAL CLOUDS. *(K otsenke fonovogo soderzhaniya ryada mikroelementov vo frontalnykh oblakakh). Text in Russian. Inst. Eksp. Meteorol., 2(36):[illegible]-76, 1972. 9 refs.*

The trace element concentrations in frontal clouds were investigated by emission spectra analysis of air samples collected by means of aircraft at altitudes between 1000 and 3000 m. The sensitivity of the spectral analysis ranged from 0.0001 to 0.00001 micrograms/cu m. Greatly varying concentrations of trace elements, such as titanium, cadmium, magnesium, iron, copper, aluminum, zinc, and manganese in frontal clouds were observed. The concentrations of Fe, Cu, Al, Zn, and Mn were highest, and those of bismuth, vanadium, tin, and silver were lowest. The trace element concentrations in frontal clouds and in frontal zones were higher than in the free atmosphere with an absence of fronts, and they occasionally reached the levels measured in the ground layer of the atmosphere in big cities. The lead, chromium, nickel, Ti, and Sn concentrations were much higher in frontal zones than in the surface-layer of the atmosphere. The trace element concentrations were highest in occluded fronts, and lowest in cold fronts. Titanium and Cd displayed the most pronounced concentration variations as a function of the type of the fronts, which suggests their use of natural tracers.

**33918** **APTIC NO. 56322**

Georgii, Hans-Walter

CARBON MONOXIDE EMISSION CONCENTRATIONS AS A FUNCTION OF METEOROLOGICAL PARAMETERS. *(Ermittlung der CO-immission- skonzentrationen unter Beruecksichtigung meteorologischer Einflussgroes-*

*sen). Text in German. Staub, Reinhaltung Luft, 32(2):70-74, 1972. 4 refs.*

Carbon monoxide concentrations were measured in streets with high traffic density (2000 vehicles/hr) in Wiesbaden and in Frankfurt am Main. Concentrations were determined as a function of time of day and of the season. Data on wind velocity, depth of street canyons, and other exhaust gases were taken into consideration. The daily mean was 20 ppm. Ventilation in the streets of these two cities was not good, and persons are exposed for long periods to concentrations of CO in excess of 50 ppm. The hourly mean values are higher than those reported for America.

**33919** **APTIC NO. 56503**

Konishi, Toshio

ATMOSPHERIC POLLUTION AND TEMPERATURE IN KAINAN CITY: ON THE INVESTIGATION ON THE INVERSION LAYER. *(Kainan-shi ni okeru taiki osen to kion: gyakutenso ni kansuru chosa ni tsuite). Text in Japanese. Wakayama-ken Eisei Kenkyusho Nenpo (Wakayama Inst. Pub. Health Ann. Rep.), no. 19:89-94, Sept. 1972. 4 refs.*

Inversions occurred on a mountain in Kainan city, and temperature, sulfur dioxide concentration, and winds were measured. The SO2 concentration was higher than 0.1 ppm. Generally, the temperature inversion took place in Kainan city at midnight; the inversion was most remarkable at 200 m above sea level. In winter the inversion occurred at 100-200 m height; in spring and summer it took place at 200-400 m. When the temperature at the top of the mountain was higher than at lower points, the SO2 concentration in the city was generally very high. The geographical characteristics of the area are discussed. The air pollution source is a plant located on the harbor coast.

**33920** **APTIC NO. 56899**

Kutsenogiy, K. P., V. I. Makarov, Yu. F. Chankin, V. M. Sakharov, and G. N. Zagulyayev

STUDY OF THE PHYSICOCHEMICAL CHARACTERISTICS OF LARGE AEROSOL WAVES. *(Izucheniye fiziko-khimicheskikh kharakteristik moshchnoy aerozol noy volny). Text in Russian. Inst. Eksp. Meteorol., no. 27:97-104, 1972. 7 refs.*

The dispersity, time-related concentration, and settling of a large pesticide aerosol wave, generated by an aerosol generator moving perpendicularly to the wind direction under atmospheric inversion conditions, were studied as a function of the distance from the aerosol generator in field tests. The respective percentages of the pesticide aerosol retained by the five stages of a cascade impactor at 1 km distance of the aerosol generator were 6% (20 micron), 5% (5.8 micron), 5% (3.7 micron), 25% (1.8 micron), and 59% (1 micron). The corresponding percentages obtained for a 6 km distance were 7%; 8%; 6%; 25%; and 54%. Strong reduction in the concentrations of fractions over 20 micron with distance was observed. Microscopic investigations of horizontally exposed glass surfaces revealed that the percentage of aerosol droplets settled at distances of 1 km or more from the aerosol generated did not exceed 5% for the fraction over 25 micron, but it reached about 90% for particles smaller than 15 micron. The dispersion of the time-related concentrations, expressed in mg/cu m/sec, decreased with increasing distance from the aerosol generator, which was due to the initial ascension of the relatively warm aerosol cloud.

**33921** **APTIC NO. 56779**

Linacre, Edward and Colin Edgar

CLIMATOLOGY OF SYDNEY IN RELATION TO AIR POLLUTION. *Clean Air Society of Australia and New Zealand, Proc. Int. Clean Air Conf., Melbourne, Australia, 1972, p. 23-30. 6 refs. (May 15-18.)*

Climatic records from Sydney between the years 1929 and 1969 were analyzed to study their relation to air pollution. The factors studied included the visibility at 9 am, temperature, occurrence of fog, duration of bright sunshine, cloudiness, rainfall, and low-speed winds. The analysis indicated that the ventilation of Sydney is likely to be affected more by the general airflow, cold air drainage, and sea breezes than by urban heating. The worst air pollution concentrations in Sydney in autumn currently may be accounted for by the relative absence of cloud in autumn and winter and the greater incidence of low winds at night in the summer and autumn; rain and sunshine data revealed no obvious effect on air pollution. A steady improvement of 9 am visibility since 1929 is partly due to a decline in the occurrence of fogs at Sydney and is associated with a decrease in the frequency of relative humdity over 90% at 9 am. It is uncertain whether air pollution from Sydney or long term trends in regional climate chiefly affects fog incidence. Photographs taken daily at 9 am near Sydney Harbor Bridge yielded a haze index which correlates with visibility distances in that both show dirtier air on weekdays. The reduction of electricity generation within Sydney since 1955 and the implementation of the 1961 N.S.W. Clean Air Act have been accompanied by an improvement of visible haze measured at 9 am. (Author conclusions modified)

**33922** **APTIC NO. 56751**

Moses, Harry and Paul E. Hess

COMPARISON OF THE SURFACE AND GEOSTROPHIC WINDS. *In: Radiological and Environmental Research Division Annual Report. Atmospheric Physics. January through December 1972. Argonne National Lab., Argonne, Ill., p. 20-38, 1972. 2 refs.*

NTIS: ANL-7960, Part IV

A relatively satisfactory air pollution model uses only wind speed. However, information on the behavior of the in situ wind field is often lacking and prediciton is difficult. Since geostrophic wind data, scaled in a manner appropriate to the particular situation, can be obtained from synoptic charts and prognoses, it is tempting to use them to predict high levels of pollution. The relationship between geostrophic and surface winds was studied, and limitations of this approach were determined. Geostrophic and surface wind speeds and directions were compared. With light geostrophic winds (less than or equal to 5 mph), surface wind speed divided by geostrophic wind speed ratios are large, i.e., values appreciably greater than unity. As the geostrophic wind increases, the ratio approaches a nearly constant value of 0.3 to 0.4. The ratios are substantially greater during the day, reaching a high in the afternoon, even with winds exceeding 35 mph. The ratio is direction-dependent, with substantially larger values occurring with northeasterly and easterly winds, i.e., trajectories over Lake Michigan. Two distinct regimes in the wind flow occur which correspond to light wind conditions of less than 10 mph and to winds exceeding 20 mph. The mean deviation of the actual wind direction from the geostrophic direction ranges from 30 deg at Argonne to 40 deg at Midway. This value remains nearly constant above 18 mph. The standard deviation of the actual wind direction is large for light winds exceeding 100 deg, but falls off with increasing wind speeds to values of 20 to 40 deg. The results provide a basis for applying correction factors to the geostrophic wind to yield an improved value of the surface wind. These corrections take into account the influence of stability and surface roughness when time of day and wind direction are used as independent variables.

**33923** **APTIC NO. 56752**

Moses, Harry and Paul E. Hess

OCCURRENCE OF LIGHT WINDS AT CHICAGO MIDWAY AIRPORT. *In: Radiological and Environmental Research Divison Annual Report. Atmospheric Physics.*

January through December 1972. Argonne National Lab., Argonne, Ill., p. 39-43, 1972.

NTIS: ANL-7960, Part IV

During light wind conditions (surface wind speeds of 5 mph or less), pollutant concentrations over urban areas are likely to increase since the rate of ventilation over the city is low. It is therefore useful to examine the frequency with which potentially hazardous conditions can be expected to occur on an hourly and seasonal basis. This was studied at Chicago's Midway Airport. The effect of atmospheric stability and horizontal pressure gradient on surface wind speed was noted. Ten percent of the hourly observations between 1966 and 1970 were light wind conditions; speeds less than 10 mph occurred nearly half the time. Light winds occurred least often during the afternoon when convective mixing was most effective. The maximum frequency of light wind conditions occurred between 2100 and 0600 hours. The maximum probability for light wind conditions was at or slightly before sunrise. Light winds occurred twice as frequently in the midsummer and early fall (July-September) as in the winter (December-March). During July and August, 65% of the hourly wind speed observations were less than 10 mph. The maximum frequency of light winds occurred in summer in spite of increased mixing due to the presence of weaker pressure systems supplying less momentum to be mixed downward and to pronounced nocturnal inversions. Light winds were frequent during early morning hours of the summer (37% of the 0500 hour July observations compared to 11% at 0500 in January). Diurnal variations were stronger in July than in other months.

**33924** **APTIC NO. 56753**

Moses, Harry and Paul E. Hess

VARIATIONS OF MEAN SURFACE WIND DIRECTION AT CHICAGO MIDWAY AIRPORT. *In: Radiological and Environmental Research Division Annual Report. Atmospheric Physics. January through December 1972. Argonne National Lab., Argonne, Ill., p. 44-48, 1972. 1 ref.*

NTIS: ANL-7960, Part IV

The variations of mean surface wind direction at various times measured at the Chicago Midway airport were used to study shifts in wind direction which might result in significant changes of pollutant concentrations. Hourly observations recorded from 1966 to 1970 by the U. S. National Weather Service were analyzed. The mean direction range increased with the length of the period. The direction range varied inversely with wind speed. Direction ranges for periods beginning at midnight were 10-20 deg smaller than those calculated for periods beginning at noon. Values of maximum clockwise and counterclockwise changes and differences between these changes over similar time intervals were tabulated. In all but a few cases, the clockwise changes exceeded those observed in the counterclockwise direction; thus, the wind can be expected to veer further than it backs. The exceptions were associated with larger wind speeds and intervals of 9 hours or more. Larger direction changes in the clockwise direction were due in part to more frequent passages of low and high pressure centers to the north of Midway Airport. Thus, average storm tracks can be used to assess probable wind direction changes qualitatively. Stronger veering was also due to the greater curvature of cyclonic isobars. These considerations should be taken into account in forecasting the long term, larger scale effects downwind of pollutants released from point sources. These results suggest a statistical approach where the systematic departures from a wind direction line at the beginning of a period of concern might be included in models designed to analyze the long term consequences of mesoscale dispersion from point sources.

**33925** **APTIC NO. 56683**

Plass, Gilbert N.

THE INFLUENCE OF THE COMBUSTION OF FOSSIL FUELS ON THE CLIMATE. *In: Electrochemistry of Cleaner Environments. John O M. Bockris (ed.), New York, Plenum Press, 1972, Chapt. 2, p. 24-46. 26 refs.*

Significant amounts of carbon dioxide are being released into the atmosphere by the combustion of fossil fuels, and a continuation of fossil fuel use increase at the present rate will result in a carbon dioxide concentration of almost four times the present amount by the year 2080. An increase of this magnitude would cause important changes in climate; it would be significantly warmer, probably drier on the whole, together with an appreciable increase in the mean level of the oceans. The resulting climatic changes would be even larger and probably intolerable when the reserves of fossil fuel become depleted. Hence, the continued use of fossil fuels in ever greater amounts cannot be tolerated. (Author summary modified)

**33926** **APTIC NO. 56510**

Yamagata, Soroku

THE MEASUREMENT OF PHOTOCHEMICAL SMOG. *(Kokagaku sumoggu taisaku) Text in Japanese. Kankyo Eisei (Environmental Sanitation), 19(3):6-12, March 1972.*

Photochemical smog measurement is discussed. Smog damage, formation mechanisms, and occurrences in Japan are discussed. Costs, control agencies, effects on human health, and a movable smog chamber are mentioned.

**33927** **APTIC NO. 56411**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV(J): EFFECT ON WEATHER AND CLIMATE. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 192-198. 4 refs.*

The effects of air pollution on weather and climate in Great Britain are discussed. Particles of dust and smoke suspended in the atmosphere can act as nuclei for condensation of water droplets, cloud formation, and eventually rain. Excessive dust can also reduce rainfall under conditions of over-seeding. There are indications that the sulfur content of rainwater is higher in regions of higher air pollution. The duration of bright sunshine during the months of Nov. to Jan. at the London Weather Centre increased 50% since 1968 compared with the long-term average, 1931-1960. This is associated with the decrease in smoke levels over London which have occurred since the Clean Air Act. There has also been a decrease in the frequency of dense fog in central London since the mid-fifties. The fact that while both carbon dioxide and particulate emissions are increasing, the mean global temperature is decreasing, could be taken to imply that the particulates are having a dominant effect at the moment.

## 1971

**33928** **APTIC NO. 56346**

Cadle, Richard D.

THE CHEMISTRY OF SMOG. *In: Man's Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 26, p. 339-359. 13 refs.*

Urban smogs generally consist of coal smoke and fog and/or photochemical smog; other types of smog, for example ice fog, also exist. The history of smog control, especially as it is practiced in Los Angeles, is outlined, and the gaseous components of smog are discussed in terms of their concentrations and origins. The particulate components are considered in terms of their concentration, size range, origins, size distribution, effect on visibility, color, and particulate composition. A series of chemical reactions triggered by the sunlight induced photochemical decomposition of nitrogen dioxide into nitric oxide and atomic oxygen is presented. Some of the single source pollutants arising from industrial processes are fluorine and various gaseous and solid fluorine compounds, and the gaseous and particulate pollutants generated by the public utility industry. No obvious trends in the concentrations of particulate pollutants in the atmosphere over the past several years have been found, although there is indication that the dust concentration is decreasing, that lead concentrations are highest where the most gasoline is consumed, and that the sulfate concentrations are highest where the fuels with the highest sulfur concentrations are burned. There are also some indications that the turbidity of the worldwide atmosphere resulting from airborne particles is increasing.

**33929** **APTIC NO. 56672**

Cadle, Richard D. and Christian E. Junge

ATMOSPHERIC NUCLEI. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 31, p. 396-399. 4 refs.*

Atmospheric condensation nuclei are those airborne particles on which water condenses to form the droplets of clouds and fogs. For the most part, they have radii of 0.1 to 1.0 micron. Generally, the aerosol particles represent a complex and variable mixture of water insoluble and water soluble inorganic and organic matter. The dominant factor in determining the supersaturation required to initiate true condensation is the size of the particles. in very clean tropospheric air masses, the total number of aerosol particles per cu cm vary between about 100 and several hundred, leaving no or almost no particles inactivated. Although sea spray aerosols are constantly formed over oceans, they do not play an important role as cloud nuclei. Since ammonium sulfate is a common constituent of these particles, particle formation from sulfur dioxide and ammonia is likely. This is apparently true for most of the troposphere, indicating that even in very clean tropospheric air, new aerosol particles may be continuously formed. Freezing nuclei are those airborne particles that lead to the change of phase of water substance from the vapor or liquid phase to the solid phase. Most are in the size range of large particles, with clay particles seeming to constitute most of such nuclei in the natural atmosphere. The concentrations of freezing nuclei in the troposphere vary greatly with time and location. Highly industrialized cities are important sources of freezing nuclei and may, therefore, modify the downwind climate. Industrial plants such as steel mills may be more important than automobiles as sources of freezing nuclei. Research is needed to determine the importance of the various effects of pollutants on cloud droplets.

**33930** **APTIC NO. 56676**

Drummond, A. J.

INSTRUMENTATION FOR THE CONTINUOUS MONITORING OF SOLAR IRRADIANCE IN GROUND-BASED STUDIES. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 29, p. 369-374.*

The solar radiation data acquisition system acquired for installation at the National Oceanographic and Atmospheric Administration s Mauna Loa Observatory in Hawaii is described. The solar radiation spectral sensors and associated readout have been designed to provide continuous monitoring of solar irradiance from the ground. Essentially, the instrumentation consists of: a sountracking multichannel radiometer (pyrheliometer) for measuring direct solar spectral radiation at normal incidence; a series of precision radiometers or pyranometers for sampling the global radiation in certain similar discrete wavelength intervals; multichannel low-level digital data acquisition with both paper printing and magnetic tape recording for use with the sensors and permitting computer handling of the data; and sensor and readout calibration equipment. The complete system is capable of extension to additional information input without recourse to redesign or new development requirements, an all components have been fully developed, are commercially available, and have operated satisfactorily routinely and under test conditions. The measurements are important for meteorological investigations, monitoring aerosol scattering, and measuring aerosol absorption.

**33931** **APTIC NO. 56651**

Edinger, James G.

METEOROLOGY. *In: Combustion-Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution Held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 145-163. 3 refs.*

Basic relationships between the structure and motion of the lowest layers of the atmosphere and the transport and dilution of introduced contaminants are examined. Two different sorts of mixing occur in the dilution of a cloud of pollution: molecular diffusion and eddy diffusion. The rate of transfer of material across the cloud or plume boundary by molecular motions is very small compared with that which is generated by eddy (fluid) motions; hence, molecular effects can be neglected. Buoyancy effects are the basic cause of most vertical mixing throughout the depth of the lower atmosphere, whereas wind is the major factor in horizontal movement. Terrain also plays a part in determining the rate at which fresh air is brought in over a source, and each locality with its unique terrain has its own varying potential for receiving new, unpolluted air depending on both general wind conditions and locally generated winds. A variety of weather situations can produce low level temperature inversions; they furnish either cooling from below or heating from above, or both, for the lower part of the atmosphere. Characteristically, subsidence is associated with anticyclones, and air tends to spiral out away from the centers of the high pressure areas producing a horizontal divergence of the air which of necessity is accompanied by sinking of the air aloft over the anticyclone. Illustrations are provided for: surface wind patterns over the Los Angeles Basin; typical summer trajectories across the Los Angeles Basin; prevailing wind patterns for the Tunuyan Valley, Argentina; variations of vertical temperature stratification with time at Gila Bend, Arizona; normal resultant wind streamlines and isotacks for the eastern Pacific Ocean in July; and temperature soundings for various areas.

**33932** **APTIC NO. 56345**

Junge, Christian E.

THE NATURE AND RESIDENCE TIMES OF TROPOSPHERIC AEROSOLS. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 23, p. 302-309.*

The troposphere contains two reservoirs of relatively short lived atmospheric aerosols: the lower half of the troposphere over continents; and the upper half of the troposphere above continents and most of the total troposphere over the oceans. The main natural sources of tropospheric aerosols are sea spray particles over oceans; dust storms from deserts and dry areas; photochemical and homogeneous gas reactions between hydrocarbons released from plants, and ozone, oxides of nitrogen, ammonia, and sulfur compounds released from the earth s surface; and volcanic eruptions. The aerosol particles vary in size from 0.01 micron in diameter to 100 micron in radius and they show a high degree of internal mixing. The following aerosol parameters can be monitored from ground stations using presently available techniques: total number concentration, optical effects, cloud nuclei concentration, ice nuclei concentration, and total mass concentration. The trends which have already been observed regarding these parameters are discussed, as is the residence time of aerosols.

**33933** **APTIC NO. 56388**

Manabe, Syukuro

ESTIMATES OF FUTURE CHANGE OF CLIMATE DUE TO THE INCREASE OF CARBON DIOXIDE CONCENTRATION IN THE AIR. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 17, p. 249-264. 22 refs.*

Plass (1956), Kaplan (1960), and Kondratiev and Niilisk (1960) have estimated the increase in the temperature of the earth s surface required to compensate for the increase in the downward terrestrial radiation caused by increases in the carbon dioxide content of the atmosphere. They took into account upward and downward terrestrial radiation and cloudiness. Moller (1963) tried to improve their estimates by taking into account relative and absolute humidity, and Manabe and Wetherald (1967) further improved them by considering the sum of the sensible and latent heat fluxes from the earth s surface to the atmosphere. The latter estimated the effects of CO2 concentration on the atmospheric temperature by comparing the state of radiative convective equilibrium which was obtained for various CO2 concentrations. To improve their one dimensional model, Budyko (1969) constructed a simple two dimensional model for the atmosphere in which the effects of poleward heat transport and radiative transfer were parameterized. In 1969, Manabe and Bryan constructed a joint ocean atmosphere model in which the oceanic and atmospheric parts of the model interacted with each other thermally as well as dynamically. This model would be useful for studying both climatic changes in the past and future climatic changes due to various human activities such as fossil fuel combustion; a high speed computer would be required for predicting the future evolution of climate over a long period of time (e.g., 100 years). A one dimensional model of radiative, convective equilibrium for evaluating the effect of increases in the output of heat energy on atmospheric temperature is discussed.

**33934** **APTIC NO. 56344**

Mitchell, J. Murray, Jr.

THE EFFECT OF ATMOSPHERIC PARTICLES OF RADIATION AND TEMPERATURE. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 22, p. 295-301. 6 refs.*

Aerosol particles can scatter and absorb the radiation passing through the atmosphere, affecting the radiative flux divergence field and the temperature distribution in the atmosphere. The combined influence of backscattering and absorption by aerosols was analyzed by Charlson and Pilat (1969), who considered a homogeneous aerosol layer in which both backscattering and absorption of solar radiation could be described by a simple Beer-Lambert relationship. Depending on the relative magnitudes of absorption and backscattering, an aerosol might either heat or cool the earth-atmosphere system. Modification of the Charlson and Pilat model to make it more realistic for quantitative application to the problem indicates that the prevailing effect of real tropospheric aerosols is more likely to warm the lower atmosphere than to cool it. Thus, increasing tropospheric aerosol produced by human activities is likely to produce a general warming of the earth s climate. An equation is presented for judging the direction of the atmospheric temperature response to the presence of particles in the lower atmosphere. The net effect of aerosols over moist surfaces may also produce a slight decrease in the average global rates of evaporation and precipitation. With stratospheric or high tropospheric aerosols, the surface climate is likely to be cooled regardless of the magnitude of warming in the aerosol layer itself. The first step in evaluating the thermal effect of atmospheric aerosol layers involves measurement of the backscattering, absorption, and other optical properties of each type of aerosol layer commonly encountered in the atmosphere.

**33935** **APTIC NO. 56373**

Newell, Reginald E. and T. G. Dopplick

THE EFFECT OF CHANGING CARBON DIOXIDE CONCENTRATION ON RADIATIVE HEATING RATES. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 19, p. 277-280. 11 refs.*

One technique for investigating the effects of changing carbon dioxide concentrations on the atmospheric temperature involves computing the radiative heating rate as the local imbalance of radiative fluxes--for each altitude and for different CO2 mixing ratios--keeping other factors constant. The local rate of temperature change produced by infrared radiative divergence due to CO2, water vapor, and ozone is shown; at lower levels the net cooling rate is slightly diminished, while at upper levels it is significantly increased by a change in CO2 from 320 to 400 ppmv. When looking for a potential influence of global pollution on the tropospheric temperature, it is wise to pay careful attention to the water cycle and is possible modification, particularly as it enters through the effect of latent heat.

**33936** **APTIC NO. 56774**

Pearson, F. J., Jr. and Donald W. Fisher

CHEMICAL COMPOSITION OF ATMOSPHERIC PRECIPITATION IN THE NORTHEASTERN UNITED STATES. *Geological Survey Water-Supply Paper 1535-P, 26p., 1971. 17 refs.*

GPO

The chemical composition of atmospheric precipitation from 18 collection sites in New York, Pennsylvania, and New England was investigated. Monthly bulk precipitation samples were collected during periods that lasted from 12 to 36 mo. The samples were analyzed for calcium, magnesium, sodium, potassium, ammonium, hydrogen ion, bicarbonate, sulfate, chloride, nitrate, and phosphate. The atmospheric precipitation was composed of a dilute Ca-H2SO4 water having additional Na and Cl near the coast. In the inland and coastal sections, except in the highly industrialized areas, variations among the precipitation chemical loads measured at various sites showed no systematic differences that suggest sectional changes in the precipitation chemistry. In the rural inland section, the average loads of all measured constituents except SO4 and H ion were independent of precipitation amount. In the coastal section, Na and Cl loads vary with precipitation, presumably owing to the effects of sea spray. Limited data showed that industrial regions are marked by the presence of higher Ca, SO4, and NO3 loads. Atmospheric precipitation contributes substantially to the chemical loads of streams, particularly those draining basins which have underlying unreactive rock. Essentially all the SO4 and nitrogen bearing ions and much of the Cl and K in such streams are supplied by precipitation. Even in areas of more chemically reactive rock, the stream loads of the nitrogenous species may still be largely from precipitation. (Author conclusions modified)

**33937** **APTIC NO. 56349**

Revelle, Roger

THE PROBABLE FUTURE INCREASE IN ATMOSPHERIC CARBON DIOXIDE--KINDS OF MONITORING FOR PREDICTION. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 20, p. 281-284. 2 refs.*

It has been estimated that by the year 2000, the world consumption of fossil fuels will have increased from approximately 5.4 billion tons to 17.8 billion tons. This would produce 1080 billion tons of carbon dioxide, or approximately half of the present atmospheric content of CO2. Thus by 2000, the atmospheric CO will have increased 30% over the level of the mid-nineteenth century. This is probably a minimum figure because additional CO2 may be released to the atmosphere due to the diminution of carbon locked in the biosphere by forest clearing or greater forest exploitation; the mean proportion of carbon dioxide added to the biosphere by fossil fuel combustion may diminish; some of the oceanic CO2 may be driven into the atmosphere if the surface layers of the ocean are warmed; and large amounts of CO2 may be released from deep ocean waters as these waters come to the surface at high latitudes. These uncertainties in the rate of addition of CO2 to the atmosphere suggest that the following kinds of monitoring and measurement should be undertaken: the total content of atmospheric CO should be continuously measured at stations where the atmosphere is thoroughly mixed and where local effects from vegetation, human activities, and vulcanism can be kept to a minimum; the average temperature at the top 400 meters of the ocean waters should be accurately monitored; oceanographic ships should look for intermittent large scale upwelling of the deep ocean waters that could release large quantities of CO2 to the atmosphere; and the partition of added CO2 between the ocean and the biosphere should be resolved. Possible changes in the weather and climate effected by increasing atmospheric CO2 should be introduced into theoretical and computer models of the general atmospheric circulation.

**33938** **APTIC NO. 56252**

Seinfeld, John H.

MODELING PROBLEMS IN AIR POLLUTION. *Simulation Councils Inc., Simulation Councils Proc., (Jan.) 1971, vol. 1, p. 33-48. 78 refs.*

The major sources of air pollutants in the U. S. are discussed in conjunction with the development of a viable simulation model of an urban airshed. Combustion of any of the fossil fuels leads to carbon monoxide, sulfur oxides, hydrocarbons, particulate matter, and nitrogen oxides. The amounts and relative proportion of these five pollutants vary widely with the types of fossil fuel and the specific combustion method. The most important in atmospheric reactions are hydrocarbons and nitrogen oxides which result in photochemical smog. The smog formulation process is detailed. The size, composition, and distribution of particulates in the atmosphere are not yet determined. A mathematical simulation of the meteorological and chemical aspects of air pollution is proposed and describes transport and dispersion in the atmosphere, the rates of atmospheric chemical reactions, and the spatial distribution and mass of emissions from motor vehicles and major fuel sources.

## 1970

**33939** **APTIC NO. 56319**

Tsuji, Kusuo and Masaharu Tonomura

OBSERVATION OF AIR POLLUTION WITH THE AID OF CONTINUOUS ANALYSERS. III: CORRELATION BETWEEN THE CONCENTRATION OF VARIOUS KINDS OF POLLUTANTS IN ATMOSPHERE AND WIND DIRECTION AND VELOCITY AT KASUMIGASEKI, CENTRAL DISTRICT OF TOKYO. *(Renzoku sokutei kirokukei ni yoru taiki osen no kenkyu (daisanpo), taikichu ni okeru osenbutsu no nodo to fusoku, fuko no kankei ni tsuite). Text in Japanese. Eisei Shikensho Hokoku (Bull. Natl. Inst. Hyg. Sci., Tokyo) vol. 88:30-36, 1970. 6 refs.*

The relationship between the pollutants and meteorological conditions is discussed. Over 40,000 data on sulfur dioxide, carbon monoxide, dust particles, and meteorological observation were obtained during 1966 at Kasumigaseki, central district of Tokyo. The resulting data were evaluated in terms of variation of pollutant levels with wind direction and velocity. When the concentration of SO2 and CO in the air are low, dispersion has no effect; however, dust particles are affected by dispersion. The pollutants are caused by automobiles and the industrial areas that surround Tokyo to the north, south, and east. It is difficult to expect dispersion bv wind at central district of Tokyo.

**33940** **APTIC NO. 56743**

Wojcicka, I.

EFFECTS OF AIR POLLUTION ON THE CLIMATE OF TOWNS. *Air Conserv. (English translation from Polish of: Ochrona Powietrza), 4(6)(20):35-39, 1970. 11 refs.*

NTIS: TT 70-55124/6

# BASIC SCIENCE AND TECHNOLOGY

## 1973

**33941** **APTIC NO. 56948**

Aoki, Kazuyuki

SPECTRUM ANALYSIS OF AIR POLLUTANT CONCENTRATION. *(Taiki osenshitsu nodo no supekutoru kaiseki--CO to O3 no sokan ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):287, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973, Paper 38.).*

The random fluctuations of air pollutant measurements are usually discarded in the process of leveling the measurements for hourly average data. In this study, spectrum analysis was applied to short cycle random fluctuations. Different pollution concentrations of two points and their cycle response functions show pollution dispersion; different concentration of different pollutants at one point give mutual reactions between pollutants. The concentrations of carbon monoxide and ozone at one location were analyzed. Ozone concentrations decreased at 1-10 c/h in proportion to function, but the CO spectrum reading was approximately flat. Coherency and functions of cycle responses were also examined. A minus correlation between O3 and CO concentrations is shown, and when they coexist, C3 in the amount of approximately 1.5% of the amount of CO is degraded.

**33942** **APTIC NO. 56916**

Ash, R., R. M. Barrer, J. H. Clint, R. J. Dolphin, and C. L. Murray

ISOTHERMAL AND THERMO-OSMOTIC TRANSPORT OF SORBABLE GASES IN MICROPOROUS CARBON MEMBRANES. *Phil. Trans. Roy. Soc. London, Ser. A, 275(1249):255-307, Sept. 27, 1973. 48 refs.*

Using helium and a series of gases adsorbed to give dilute films, measurements were made of thermo-osmotic steady-state pressure ratios established across microporous carbon membranes through which linear temperature gradients were maintained. Two adsorbents were employed. Carbolac I, a carbon black having an energetically heterogeneous high surface area, and Graphon, a graphitized carbon black of 1/10 the surface area of Carbolac but energetically homogeneous. The equilibrium properties of the adsorbed films were studied, along with the isothermal transport of the gases through the membranes and the thermo-osmotic transport of the gases in the membranes. (Author summary modified)

**33943** **APTIC NO. 56646**

Axworthy, A. E. and M. Schuman

INVESTIGATION OF THE MECHANISM AND CHEMISTRY OF FUEL NITROGEN CONVERSION TO NITROGEN OXIDES IN COMBUSTION. *Environmental Protection Agency, Research Triangle Park, N. C., Proc. Coal Combust. Semin., Research Triangle Park, N. C., 1973, p. 9-41. 7 refs. (June 19-20.)*

NTIS: PB 224210/AS

A progress report which covers approximately the first half of an analytical and experimental program conducted to determine and model the kinetics and mechanism of the decomposition of fuel nitrogen compounds, the fate of nitrogen-containing pyrolysis products, and the important physical and chemical processes in the formation of nitrogen oxides from these species in flames is presented. Results of a preliminary calculation with a kinetic/diffusion model for NO. 2 fuel oil are given and indicate that the rate of formation of thermal nitric oxide is strongly dependent on the free-stream temperature with this model. The use of this model to predict the rate of formation of thermal NO must therefore await extention of the model during a later phase of experimentation. Results of pyrolysis experiments using model nitrogen compounds, a number of fuel oils, and one coal sample are also given; experimental decomposition curves were fitted to rate expressions for use in the combustion models. The amount of hydrogen cyanide formed was strongly temperature dependent and ranged from 24-89% of the nitrogen in the sample at 1100 C to less than a few percent at temperatures of 1000 C and lower. Unrecovered nitrogen in these experiments appeared to be contained in the carbonaceous residue present in the reactor after each experiment. Fuel pyrolysis results have been encouraging in that they indicate that real fuels behave similarly to the model compounds.

**33944** **APTIC NO. 56913**

Borho, Klaus

AGGLOMERATION AND WALL DEPOSITION IN GAS-SOLID STREAMS DUE TO ELECTROSTATIC CHARGE. *(Agglomeration und Wandansatz bei Gas/Feststoff-Stroemungen aufgrund elektrostatischer Aufladungen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 190-181-185, 1973. 12 refs.*

Theoretical study and experiments concerning the brownian coagulation and wall deposition of dusts in gas-dust streams in pipes and canals are described. The decrease in the dust concentration due to agglomeration and wall deposition along pipes and canals was dependent on the flow rate and the air humidity content. The rate of coagulation was largely independent of the flow rate. Primary particle layers deposited on walls failed to hinder continued dust deposition. All dust fractions deposited on pipe and canal walls at the same probability. A high bipolar charge of the dust led to considerable acceleration of agglomeration. The rate of wall deposition, determined experimentally, was much higher than that calculated on the basis of theories ignoring the effect of electrostatic charge. The mean charge of the particles was determined to be the dominant parameter regarding agglomeration and wall deposition.

**33945** **APTIC NO. 56832**

Chylek, Petr

MIE SCATTERING INTO THE BACKWARD HEMISPHERE. *J. Opt. Soc. Am., 63(11):1467-1471, Nov. 1973. 6 refs.*

The integration of the scattered flux over the backward hemisphere can be performed analytically. The final formula contains only the Mie-scattering functions a sub k(x,m) and b sub k(x,m) and numerical coefficients determined by the summation indices. Using a suitable program for the calculation of the Mie functions a sub k and b sub k, the Mie scattering into the backward hemisphere can readily be evalated. The scattering into the forward hemisphere is given by an expression that has the same form as the formula for the scattered flux over the backward hemisphere with, however, minus signs in front of the double sums. The Mie scattering into a given solid angle can be evaluated from another formula. The integrating over the scattering angle was partially done and the only integral remaining for numerical integration has a relatively simple form. (Author conclusions)

**33946** **APTIC NO. 56945**

Detournay, J. P. and R. H. Jadot

DETERMINATION OF THE REACTIVE PHASE OCCURRING DURING ABSORPTION OF NITROGEN OXIDES IN WATER. *(Determination de la phase reactive lors de l absorption des oxydes d azote dans l eau). Text in French. Chem. Eng. Sci., 28(11):2099-2102, Nov. 1973. 14 refs.*

The absorption mechanism of nitrogen dioxide and nitrogen trioxide in water was studied to determine the reactive phase during this process. Reactions between NO3 and water vapor in the homogeneous gaseous phase was found to occur. The kinetic constant determined revealed that the rate of reaction is much lower than in the aqueous phase. There is an inexpediency of increasing the volume of the gaseous phase in industrial installations for the absorption of nitrogen oxides in water.

**33947** **APTIC NO. 56666**

Dimitriades, B.

PHOTOCHEMICAL OXIDANTS. *Preprint, Environmental Protection Agency, Research Triangle Park, N. C., 12p., April 1973.*

The scientific evidence and reasoning that was used as the basis in the development of the Environmental Protection Agency s photochemical oxidant control strategy is reviewed. The oxidant buildup depends on a number of factors including: concentration of organic pollutants, concentration of nitrogen oxides, ratio of organics to NOx, sunlight intensity, temperature, humidity, and dust levels. Smog chamber data indicate that control of NOx, unless unrealistically drastic, cannot achieve the oxidant standard, and control of hydrocarbons to reduce the ambient levels to 0.20 to 0.25 ppm C is necessary to meet the oxidant standard. The value of 0.24 ppm C was adopted and promulgated by EPA as the national air quality standard for HC, consistent with the oxidant standard. Curves have been recommended by EPA for use in the development of state implementation plans as regards HC control. The following inadequacies remain present in the oxidant control strategy: for regions where oxidant exceeds 0.30 ppm, control requirements cannot be obtained from these curves; the measurement error is relatively large for low concentrations; the composition of the hydrocarbon pollutants appears to vary from locality to locality; and oxidant transport phenomena were not given adequate consideration in the development of the present strategy. Oxidant-oxidant precursor studies utilize the empirical and the mathematical modeling approach. The latter may provide the key to predicting oxidant levels from emission and meteorological data. EPA is also sponsoring a program of development of instrumental air analysis, as well as studies concerned with oxidant transport phenomena, natural sources of oxidant, and the effects of emission changes.

**33948** **APTIC NO. 56705**

Foote, Christopher S., Stephen Mazur, Paul A. Burns, and Duane Lerdal

CHEMISTRY OF SINGLET OXYGEN. XVII. 1,4-ADDITION PRODUCTS FROM STYRENE DERIVATIVES. *J. Am. Chem. Soc., vol. 95:586-588, 1973. 26 refs.*

During photooxygenation of several styrene-type olefins to give products of an unusual type, dioxetanes were not detected. The 1,1-diphenyl-2-methoxyethylene was photooxygenated in benzene with dinaphthalenethiophene. One equivalent of oxygen was absorbed. Gas-liquid chromatography showed only 10% of benzophenone, the product of oxidative cleavage. The major product (85%) was gamma-lactone. When the reaction mixture was chromatographed on silica gel, two new products were isolated, methyl ester and colorless unstable crystals. Several experiments were carried out to determine the reaction mechanisms involved. The results suggested that a reinvestigation of the photooxygenation of indene was warranted. Products were analyzed by infrared spectrometry. Reaction mechanisms and chemical structure of the products are described.

**33949** **APTIC NO. 56840**

Gardner, J. L. and J. A. R. Samson

304 A PHOTOELECTRON SPECTRA OF CO, N2, O2, AND CO2. *J. Electron Spectrosc. Relat. Phenomena, 2(3):259-266, 1973. 20 refs.*

Photoelectron spectra were recorded with 30[illegible] A helium II radiation, dispersed with a grazing incidence monochromator, from carbon monoxide, nitrogen, oxygen, and carbon dioxide. For these molecules, transitions to electronic states with ionization potentials in the range 30 to 40.8 eV are dissociative. Preliminary branching ratios for transitions to all electronic states appearing in each spectrum at 304 A are given. (Author abstract)

**33950** **APTIC NO. 56568**

Gordon, Robert J. and M. C. Lin

THE REACTION OF NITRIC OXIDE WITH VIBRATIONALLY EXCITED OZONE. *Chem. Phys. Letters (Amsterdam), 22(2):262-268, Oct. 1, 1973. 18 refs.*

The reaction between nitric oxide and vibrationally excited ozone was studied in a fast flow reactor by monitoring the visible emissions from electronically excited nitrogen dioxide. The antisymmetric mode (v3) of ozone was excited with a Q-switched 9.6 micron carbon dioxide laser, and a laser-induced signal was detected, with a rise rate constant of (4.0 + or 0.1) times 10 to the 11th power cu cm/mole sec for an NO-rich mixture. The latter was unaffected by the addition of large amounts of helium or argon, indicating that the signal was not a thermal effect. Most of the measurements were made at 350 K; however, the He and Ar dilution results suggest that the enhanced reaction rate is not very sensitive to temperature. In order to explain the observed rise times, it was necessary to postulate an intermediate step prior to the chemical reaction. A model which is consistent with the data obtained has energy transferred from v3 to v2 (the bending mode) at a rate of (2.9 + or 0.5) times 10 to the 11th power cu cm/mole sec for NO and a rate of (1.1 + or 0.2) times 10 to the 11th power cu cm/mole sec for He. According to this model, the rate constant for the reaction of NO with ozone (v2 equals 1) producing vibrationally excited ground state NO2 is (1.5 + or 0.2) times 10 to the 11th power cu cm/mole sec, and the relative rate for the reaction of ozone (v2 equals 1) and ozone (v2 equals 0) with NO is k3(1)/k3(0) approximately equals 22. (Author abstract modified)

**33951** **APTIC NO. 56487**

Ham, Joop van and Heiko Nieboer

IRRADIATION OF OUTDOOR AIR: THE EFFECT OF CHANGING EMISSION QUANTITIES ON PHOTOCHEMICAL SMOG FORMATION. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C102-C105. 13 refs.*

A technique for irradiating atmospheric samples has been modified by using artificial light in an effort to estimate future oxides of nitrogen and hydrocarbon emissions and for possibly revealing future trends in photochemical smog formation in the Netherlands. Ambient air at some future date may be simulated by supplying NO and/or car exhaust gas in amounts consistent with estimates of future increase. Addition of NO raised the nitrogen dioxide maximum as well as its dosage, while ozone concentration tended to a slightly higher maximum. The rate of ozone formation, however, decreased. Ozone dosage during the first 4 hr was substantially lower than in the control. The addition of 2.5 ml of car exhaust gas to an air sample collected increased the acetylene concentration (3.6 ppb) by about 50%. The ratio of total hydrocarbons to total nitrogen oxides in the exhaust gas was about two; thus the NO concentration had increased only slightly. The retarding effect of the addition of NO on the rate of ozone formation does not appear to be counterbalanced by the accelerating effect of the hydrocarbons. Graphical comparisons are given for peak concentrations of ozone outdoors and in the laboratory conditions.

**33952** **APTIC NO. 56858**

Happel, John, Robert E. Lief, and Reiji Mezaki

A THEORETICAL MODEL SUITABLE FOR HIGHER CONVERSION DATA OF SULFUR DIOXIDE OXIDATION. *J. Catalysis, 31(1):90-95, 1973. 10 refs.*

A theoretical model has been developed to adequately correlate higher sulfur dioxide oxidation conversion data. The model includes a potential term with an apparent stoichiometric number which is, in general, a function of experimental conditions. The usefulness of the model is demonstrated by employing existing kinetic data for the oxidation reaction. This model can be applied to the catalytic oxidation of SO2 in the manufacture of sulfuric acid. (Author abstract modified)

**33953** **APTIC NO. 56582**

Hughes, B. M., C. Lifshitz, and T. O. Tiernan

ELECTRON AFFINITIES FROM ENDOTHERMIC NEGATIVE-ION CHARGE-TRANSFER REACTIONS. III. NO, NO2, SO2, CS2, CL2, BR2, I2, and C2H. *J. Chem. Phys., 59(6):3162-3181, Sept. 15, 1973. 63 refs. (Presented at the Conference on Mass Spectrometry and Allied Topics, Annual, 18th, San Francisco, Calif., June 1970 and the Symposium on Molecular Structure and Spectroscopy, 27th, Columbus, Ohio, June 1970, Paper K-6.)*

Translational energy thresholds were measured for electron transfer reactions from various atomic negative ions to nitric oxide, nitrogen dioxide, sulfur dioxide, carbon disulfide, chlorine, bromine, iodine, and acetylene using a tandem mass spectrometer. These thresholds, corrected where necessary for thermal broadening, were utilized with known thermodynamic data to calculate electron affinities for the molecules indicated. These results are consistent with electron affinity limits established by observations of certain exothermic reactions of the molecular negative ions. The isotope distributions in the products from the reactions of monoisotopic Cl and Br- with natural Cl2 and Br2, respectively, suggest that these reactions proceed via a linear X3 intermediate in which good mixing of the available energy occurs. The implications of this model with respect to the significance of the measured energy thresholds are discussed. (Author abstract)

**33954** **APTIC NO. 56918**

Kafarov, V. V., V. L. Perov, and S. D. Blonskiy

ANALYSIS OF A DYNAMIC MODEL OF THE TWO-STAGE MONOETHANOLAMINE PURIFICATION OF COKE GAS BY GRAPH THEORY. *(Analiz dinamicheskoy modeli dvukhstupenchatoy monoetanolaminovoy ochistki kokosvogo gaza metodami teorii grafov). Text in Russian. Khim. Tekhnol., no. 4:53-57, 1973. 4 refs.*

The dynamic model of the two-stage monoethanolamine purification of coke gas from hydrogen sulfide and carbon dioxide was analyzed by the graph theory. The coke gas to be purified is subsequently led through two absorbers, which are sprayed with monoethanolamine of different concentrations and purity. The vaporhgas mixture from the second absorber is led into the desorber in the first stage. Fresh monoethanolamine solution is added into the circulation system of the second stage, while the spent solution from the first stage is removed for vacuum regeneration. The dyanamic model of the two-stage coke gas purification includes such parameters as the coke gas input volume, the HS2 concentration in the coke gas, the solution expenditure, the inlet temperature of the solution, the HS2 content in the regenerated solution and in the spent solution, the rhodanide and thiosulfate contents in the solution, the solution level in the absorber, the solution outlet temperature, the solution expenditure for the desorber, the H2S content in the saturated solution, the monoethanolamine concentration in the saturated solution, the steam expenditure in the boiler, the vapor tension in the latter, the solution level in the desorber, pressure occurring in the desorber, the amount of solution removed from the desorber, the solution temperature at the desorber outlet, amount and temperature of the vapor-gas mixture, amount and temperature of the cooling water entering the cooler, the HS2 content in the gas from the first stage, and in the purified gas. Mathematical description is given of the dependence of the residual HS2 concentration in the purified gas of the initial HS2 concentration.

**33955** **APTIC NO. 56457**

Kerker, Milton and Vladimir Hampl

SCAVENGING OF AEROSOL PARTICLES BY A FALLING WATER DROP AND CALCULATION OF WASHOUT COEFFICIENTS. *Preprint, American Chemical Society, Washington, D. C., 35p., 1973. 19 refs. (Presented at the American Chemical Society, National Meeting, 166th, Chicago, Ill., Aug. 26-31, 1973.)*

Collection efficiencies of falling water drops ranging from 0.094-0.254 cm in radius for silver chloride aerosol particles in nitrogen ranging from 0.15-0.6 micron in radius were measured. The drops accelerated for distances ranging from 30-515 cm prior to entrance into a scavenging chamber. Results were extrapolated to terminal velocity. There was rough agreement for the slower moving drops (30 cm acceleration distance) with the predictions of a theory based upon collection by Brownian diffusion, although near terminal velocity Brownian diffusion theory did not account for the results. The collection efficiency was a sharply increasing function of the impaction parameter for each value of particle radius. Calculations of washout coefficients indicated that the half-life time of tenth micron aerosol particles is of the order of one day for moderate rainfall rates. This result, however, is strongly dependent upon the particular raindrop size distribution. (Author abstract modified)

**33956** **APTIC NO. 56670**

Knebel, William J. and Robert J. Angelici

KINETIC AND EQUILIBRIUM STUDIES OF BI- AND TRIDENTATE CHELATE RING-OPENING REACTIONS OF METAL CARBONYL COMPLEXES. *Preprint, Iowa State Univ., Ames, Dept. of Chemistry, 22p., 1973. 11 refs.*

Kinetic and equilibrium studies of bi- and tridentate chelate ring opening reactions of metal carbonyl complexes were made. Complexes of the type molybdenum carbonyl(P-N) where P-N is a pyridyl phosphine didentate ligand, react with carbon monoxide to give the pyridyl displaced Mo(CO)5(P-N) product. The rate law shows a first order dependence on both Mo(CO)4(P-N) and CO concentrations. In the presence of high concentrations of trifluoroacetic acid, the pyridyl group is rapidly protonated in the 5-coordinate intermediate and the rate of ring opening becomes much faster and independent of CO concentration. The overall rates of ring opening (klk2/K-l) and also the k sub 1 values increase with the increasing size of the chelate ring. Equilibrium studies of these reactions show that the formation of Mo(CO)5(P-N) is much more complete for the 7-membered chelate than for the 6-membered analog. Thermodynamic parameters, delta H and delta S, for the reaction of Mo(CO)4((C6H5)2PCH2CH2C5H4N) with CO are -8.9 kcal/mole and -12.3 e. u., respectively. The complex, fac-Mo(CO)3(PNP), where PNP is ((C6H5)2PCH2CH2)2NC2H5, reacts with CO to give cis-Mo(CO)4(PNP) in which the N-atom is no longer coordinated. The rate of this reaction is also first order in complex and in CO suggesting a mechanism analogous to that for the Mo(CO)4(P-N) complexes. Equilibrium studies yielded delta H and delta S values of -10.5 kcal/mole and -17.1 e. u., respectively for this reaction. (Author abstract modified)

**33957** **APTIC NO. 56723**

Komiyama, Kunihiko and John B. Heywood

PREDICTING NOX EMISSIONS AND EFFECTS OF EXHAUST GAS RECIRCULATION IN SPARK-IGNITION ENGINES. *Preprint, Society of Automotive Engineers, Inc., New York, 19p., 1973. 25 refs. (Presented at the Society of Automotive Engineers Automobile Engineering Meeting, Detroit, Mich., May 14-18, 1973, Paper 730475.)*

An improved theoretical model that predicts the nitric oxide concentration in the exhaust of a spark-ignition engine has been evaluated over a wide range of fuel-air ratios, percentage of exhaust gas recycled, and engine speed. Experiments were conducted with a standard CFR single-cylinder engine, and comparison of the measured and calculated exhaust NO concentrations showed good agreement over all operating conditions. Nitric oxide concentrations were found to freeze early in the expansion stroke for lean mixtures, while freezing occurred later for rich mixtures after all the charge had been burned and substantial NO decomposition occurred. Effects of exhaust gas recirculation on flame speed, ignition delay, and cycle-to-cycle pressure variations were also evaluated, and a simple model relating cycle-to-cycle variations with changes in ignition delay was developed. (Author abstract modified)

**33958** **APTIC NO. 56859**

London, Jack W. and Alexis T. Bell

A SIMULTANEOUS INFRARED AND KINETIC STUDY OF THE REDUCTION OF NITRIC OXIDE BY CARBON MONOXIDE OVER COPPER OXIDE. *J. Catalysis, 31(1):96-109, 1973. 22 refs.*

Infrared spectroscopy was used to observe the surface of a silica supported copper oxide catalyst during the reduction of nitric oxide by carbon monoxide. Spectra taken under reaction conditions show the presence of adsorbed CO, carbon dioxide, NO, and nitrous oxide, as well as carbonate and nitrate structures which characterize the degree of oxidation of the catalyst surface. An additional band observed at 2200/cm and found only under reaction conditions was assigned to an isocyanate structure of the form Cu+NCO-. The presence of this species together with other observations strongly supports the postulation that NO can dissociate upon adsorption. By combining the spectral observations with measurements of the reaction kinetics, a reaction mechanism consisting of nine elementary steps was developed. The principal assumptions underlying this mechanism are that NO dissociates upon adsorption, that N2O acts as an intermediate in the formation of nitrogen, and that CO maintains the catalyst surface in a reduced state as well as competing for sites needed for the dissociation of NO. An equation is presented for the rate of NO consumption, based on the proposed mechanism. The catalytic reduction of NO is an important control method for NO removal.

**33959** **APTIC NO. 56580**

Merryman, Earl L. and Arthur Levy

NOX FORMATION IN COMBUSTION: ANOMALOUS-EARLY NO2 FORMATION. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C117-C120. 13 refs.*

Studies were conducted to examine the role of the nitrogen fixation process (thermal oxidation of atmospheric nitrogen) and of the oxidation of nitrogen-containing species in producing nitrogen oxides in flames. Chemiluminescence data showed a very definite reading for nitrogen dioxide in the post-flame region of a lean methane flame and essentially no NO2 in the post-flame region of a stoichiometric methane flame. Initial appearance of nitric oxide was very abrupt in each flame, with formation beginning at or just above the top edge of the visible flame. The rate of NO formation was extremely rapid, especially compared with the rates of formation of water vapor and carbon dioxide in either flame. Oxygen atoms appeared early in the flame in the region of the flameholder. The appearance of NO2 before the appearance of NO in the flame system was perplexing; and its appearance remains to be determined as a real or an experimental artifact. Some mechanisms were proposed for its formation. Addition of monomethylamine (less than 100 ppm) resulted in more than 60% of the amine appearing as NO in the post-flame gases in near stoichiometric and oxygen-rich flames. A significant drop in NO formation occurred in the fuel-rich system. The presence of CH3NH2 in the flame system resulted in an extension of the NO composition curve well into the visible flame zone; thus the presence of very small quantities of N-containing species in a fuel can produce NO, even though the flame temperature is well below that needed for N2-fixation

**33960** **APTIC NO. 56641**

Quan, Victor, James R. Kliegel, Nick Bayard de Volo, and Donald P. Teixeira

ANALYTIC SCALING OF FLOWFIELD AND NITRIC OXIDE IN COMBUSTORS. *Environmental Protection Agency, Research Triangle Park, N. C., Proc. Coal Combust. Semin., Research Triangle Park, N. C., 1973, p. 43-83. 10 refs. (June 19-20.)*

NTIS: PB 224210/AS

Criteria for flow and chemical similarity, including nitric oxide formation in turbulent flows, were derived from conservation equations. Flowfield and primary combustion product concentrations in full-scale combustors were demonstrated capable of practical simulation in laboratory subscale combustors, notwithstanding the fact that NO concentration is proportional to the combustor characteristic dimension, if the nonlinear effect of radiation heat loss is neglected. Similarity conditions required only that the geometries and boundary conditions be similar for gas fired combustors; while only one additional particle size scaling relation had to be satisfied for oil-fired units. Additional burning rate scaling relations were found imposed for coal-fired units. (Author abstract modified)

**33961** **APTIC NO. 56839**

Ris, J. de

MODELING TECHNIQUES FOR PREDICTION OF FIRES. *Appl. Polymer Symp., no. 22:185-193, 1973. 15 refs.*

The state-of-the-art of fire modeling is reviewed. Two modeling techniques are discussed: Froude (or Atmospheric) Modeling, and Pressure Modeling. The advantage of Froude modeling is the ready availability of suitable experimental facilities, whereas the advantage of pressure modeling is its accuracy and generality. Froude modeling, which maintains the balance of buoyancy and inertial forces, can successfully model many fully turbulent flows including steady and certain transient fires, provided viscous effects do not become important. On the other hand, pressure modeling, which maintains the balance of buoyancy inertial, and viscous forces by an increase in ambient pressure, models both laminar and turbulent fires, including essentially all transient phenomena. However, pressure modeling does require the availability of a suitable pressure vessel. Both these modeling techniques are now well enough advanced to answer a wide variety of pressing applied research problems facing the fire protection community. (Author summary)

**33962** **APTIC NO. 56719**

Seinfeld, John H., Thomas A. Hecht, and Philip M. Roth

EXISTING NEEDS IN THE EXPERIMENTAL AND OBSERVATION STUDY OF ATMOSPHERIC CHEMICAL REACTIONS. (INTERIM REPORT). *Systems Applications, Inc., Beverly Hills, Calif., Environmental Protection Agency Contract 68-02-0580, Proj. ROAP 26AAD, Task 10, Program Element No. 1A1008, EPA-R4-73-031, R73-21, 357p., June 1973. 174 refs.*

NTIS: PB 224203/AS

Suggested programs are presented to provide information essential to the development of photochemical kinetic models in describing atmospheric pollutants. Attention is focused upon kinetic and mechanistic studies of individual reactions and free radical initiation, smog chamber studies, and atmospheric measurement programs that should be undertaken to provide the necessary data for model development. Existing deficiencies in the knowledge of each of these areas and the types of programs needed to provide such information are examined in detail. A short history of model development which describes the various photochemical mechanisms developed to date is also included. (Author abstract modified)

**33963** **APTIC NO. 56532**

Suzuki, Shin

RECENT SITUATION ON PHOTOCHEMICAL SMOG (3). *(Saikin no kokagaku sumoggu ni tsuite (3)). Text in Japanese. Netsu Kanri to Kogai (Heat Management Public Nuisance), 25(10):70-78, Oct. 1973. 1 ref.*

Smog chamber and field experiments on photochemical smog done by the Tokyo Inst. of Pollution are described. Production of pollutants is described. Oxidants consist of 80-90% ozone, 5% peroxyacetyl nitrate, and 20% nitrogen oxides. No correlation has been found between oxidants and aldehydes. The correlation between oxidants and sulfates is negative, which does not agree with experimental results from a smog chamber in the U. S.; this may be due to moisture.

**33964** **APTIC NO. 56696**

Taarit, Y. Ben and J. H. Lunsford

ELECTRON PARAMAGNETIC RESONANCE EVIDENCE FOR THE FORMATION OF SO3- BY THE OXIDATION OF SO2- ON MGO. *J. Phys. Chem., 77(11):1365-1367, 1973. 18 refs.*

Molecular oxygen reactions with a high concentration of sulfur dioxide (-) ions on magnesium oxide forming stable sulfite radicals. The electron paramagnetic spectra of S(33)03(-) is characterized by a nearly isotropic line with g equal to 2.0034 + or 0.0003 a parallel equal to 147 + or - 2 G and a perpendicular equal to 102 + or 2 G. The sp hybridization on the sulfur atom indicates an OSO bond angle of 112 deg. At 25 deg, the ion appears to librate in a plane which includes the symmetry axis. Reactions involving the SO2(-) ion on surfaces are important in determining the importance of this species in the catalytic oxidation and reduction of sulfur dioxide. (Author abstract modified)

**33965** **APTIC NO. 56843**

Takagi, Toshimi, Kenichi Fujii, and Mitsunobu Ogasawara

NITRIC OXIDE FORMATION AND CARBON MONOXIDE DECAY IN THE POST- REACTION ZONE OF A PREMIXED PROPANE-AIR FLAT BURNER FLAME. *Fuel, 52(4):294-299, Oct. 1973. 18 refs.*

The concentrations of the combustion products, especially carbon monoxide and nitric oxide, from a propane-air premixed flat burner flame were measured along the gas stream beyond the flame, and the results examined in conjunction with chemical-kinetic calculations. The data indicated that the formation and stabilization (with falling temperature) of nitric oxide in stoichiometric or fuel-lean flames can be predicted by two reactions (O + N2 yields NO + N and N + O2 yields NO +

O), and that the relative discrepancy between kinetic and simplified partialaequilibrium models near the flame decreases downstream. For fuel-rich flames, very rapid NO formation was observed in the reaction zone; this cannot readily be explained by the above reactions in the post-reaction zone even if oxygen-atom overshoot is taken into account. The excess concentration of CO observed just beyond the fuel-lean flame disappears rapidly along the gas flow, within about 3 ms. Its decay rate is dependent on a recombination reaction (H + OH + M yields $H_2O$ + M), while the conversion reaction (CO + OH yields $CO_2$ + H) is so rapid that it can be presumed to be in partial equilibrium immediately beyond the fle. (Author abstract)

**33966 APTIC NO. 56944**

Zaslonko, I. S., S. M. Kogarko, Ye. V. Mozzhukhin, and V. N. Smirnov

OSCILLATORY NON-EQUILIBRIUM IN THE $N_2O$-CO REACTION. *(Kolebatel naya neravnovesnost v reaktsii N2O s CO). Text in Russian. Dokl. Akad. Nauk SSSR, 212(5):1138-1141, Nov. 1973. 10 refs.*

The oscillatory non-equilibrium of the highly exothermal reaction of nitrogen dioxide with carbon monoxide was studied in a shock tunnel, using $N_2O$ to CO ratios of 1:1 and 1:36 in a temperature of 1200-2000 K and a pressure range of 1.5-3.5 at. The degree of the oscillatory excitation of the reagents was recorded as a function of the infrared radiation. The high rate of $N_2O$ destruction at temperatures below 2000 K was preceded by an induction period characterized by a slight increase in the optic density at 1500 K, and an increase in the intensity of the infrared irradiation. The native oxygen concentration showed exponential growth during the induction period. After the reaction took place, the intensity of the recombination-provoked luminescence fell to zero. The reaction of $N_2O$ with CO yielded molecular nitrogen with carbon dioxide, molecular nitrogen with native oxygen, while native oxygen with $N_2O$ yielded nitric oxide or molecular oxygen with molecular nitrogen. The oscillatory non-equilibrium of the $N_2O$-CO reaction was evidenced by the increase in the infrared irradiation prior to a considerable loss of $N_2O$, the increased absorption of $N_2O$ during the induction period, and especially by the exponential growth of the native oxygen concentration during the induction period.

## 1972

**33967 APTIC NO. 56895**

Aleksandrov, E. L. and N. P. Yasevich

RELATIONSHIP BETWEEN THE MINERAL CONTENT AND THE ELECTRIC CONDUCTIVITY OF ATMOSPHERIC PRECIPITATION. *(Svyaz mineralizatsii i elektroprovodnosti vody atmosfernykh osadkov). Text in Russian. Inst. Eksp. Meteorol., 2(36):77-95, 1972. 10 refs.*

Data on the inorganic contents and the electric conductivity of 746 monthly precipitation samples collected at 11 different stations in the European USSR territory were analyzed to establish possible relationships between the inorganic content and the electric conductivity. The variation coefficients of the inorganic content and the electric conductivity lie within a range of 46-70%, while the variation coefficient of the hydrogen ion concentration is in a range of 70-450%, due to the pH absolute value being 5.59. Close correlation between the inorganic content and the electric conductivity with a two-by-two correlation coefficient of 0.824-0.976 was established. The observed lack of correlation between the acidity and the electric conductivity is due to the rather low hydrogen ion concentration in atmospheric precipitation. Good agreement between the electric conductivity values, calculated from the individual ion concentrations, and the actual measured electric conductivity was observed.

**33968 APTIC NO. 56785**

Babcock, Lyndon R., Jr., Eugene V. Ryan, and Niren L. Nagda

AIR POLLUTION, ENERGY USE, AND URBAN FORM. *Purdue Univ. Int. Symp. Syst. Eng. Anal., Lafayette, Ind., 1972, p. 19-24. 9 refs.*

A proposal is presented that energy parameters be used to meaningfully relate technical as well as socio-economic aspects, such as urban form and affluence, toward prediction of air pollution propensities of urban areas. The combination of many diverse variables within a generalized computer simulation, called urbsim, is presented to illustrate the effects of input changes upon overall air quality and upon energy cost. Major urbsim inputs include: transportation energy, residential and commercial energy, industrial energy, energy supply distribution, meteorology, urban configuration, and economics. The response curves indicate that there are many ways to reduce air pollution; an optimal strategy would combine several techniques to achieve the desired air quality at the least cost. Improved emission recovery efficiency, for instance, can be employed to achieve any desired air quality, but costs of this strategy become prohibitive at higher recovery efficiencies. Alternatively, decreased energy usage, based on the present energy mix, would have a significant beneficial effect on air quality. Another response curve indicates that reduced affluence would result in improved air quality.

**33969 APTIC NO. 56368**

Biller, William F., Michael Manoff, Jyotin Sachdev, William C. Zegel, and David T. Wade

MATHEMATICAL EXPRESSIONS RELATING EVAPORATIVE EMISSIONS FROM MOTOR VEHICLES WITHOUT EVAPORATIVE LOSS-CONTROL DEVICES TO GASOLINE VOLATILITY. *Preprint, Society of Automotive Engineers, New York, 26p., 1972. (Presented at the Society of Automotive Engineers. National West Coast Meeting, San Francisco, Calif., Aug. 21-24, 1972, Paper 720700.)*

The effects of fuel volatility characteristics on evaporative emissions from motor vehicles without evaporative loss-control devices was studied, and a simple mathematical expression relating evaporative emissions from an urban car population to gasoline volatility parameters was derived. Information available on daily urban area vehicle use and data on how fuel system temperatures vary with vehicle, vehicle use, and ambient temperature were used to develop a general model for calculating daily evaporative emissions from a vehicle population, given the ambient temperature conditions and fuel volatility parameters. Linear regression analyses on the calculated data resulted in a simple mathematical expression for predicting the daily average evaporative emission from motor vehicles. The expression makes possible the study of effects of changes in gasoline volatility characteristics on evaporative emissions from uncontrolled motor vehicles. (Author abstract modified)

**33970 APTIC NO. 56695**

Corrsin, S

BACKWARD DIFFUSION IN TURBULENT FLOW. *Phys. Fluids, 15(6):986- 987, June 1972. 4 refs.*

Reverse diffusion denotes the dispersion of starting point locations (at t equals 0, say) for all fluid material points (in an ensemble of realizations) which arrive at any specified corrdinate location x at any specified time t. For hemogeneous, unsheared, stationary turbulence, the dispersion of the starting position for an ensemble of material points which arrive at x at t equals the dispersion of material points starting at position x, in the same time interval. Thus, the backwark displacement statistical properties are equal to the forward displacement properties. A new kind of Eulerian velocity whose correlation function in time is equal to that of the Lagrangian material point velocity is used to show that the assumption of equality of time dependences of the second moments is correct.

**33971** **APTIC NO. 56729**

Dimitriades, B., B. H. Eccleston, G. P. Strum, and C. J. Raible

CHARACTERISTICS AND PHOTOCHEMICAL REACTIVITY OF EMISSIONS. (FINAL REPORT). *Bureau of Mines, Bartlesville, Okla., Bartlesville Energy Research Center, Environmental Protection Agency Interagency Agreement EPA-IAG-0138(D), EPA-R2-73-276, Program Element 1A1010, 98p., Dec. 1972. 35 refs.*

NTIS: PB 223647/AS

The relationship between automotive fuel composition and exhaust reactivity was studied in an experimental program involving testing with different automotive engines and with gasolines of varied composition. Fuel composition was determined by gas chromatography. Exhaust reactivity was estimated from detailed composition data and determined directly using a smog chamber. The results showed the exhaust reactivity to increase with increasing levels of polyalkylbenzenes in the fuel. No other systematic patterns of high significance were detected. Evidence suggests, however, that the lack of relatability between exhaust reactivity and fuel composition was a result of an inappropriate definition of fuel composition. For the purposes of the study, fuel composition should be defined and expressed in terms of component groups such that the potential for exhaust reactivity would be the same within each group and different from group to group. The classification of fuel components in terms of the paraffins-olefins-aromatics groups does not meet the latter requirements. For the appropriate classification of fuel components, more information is needed on the combustion of hydrocarbons in the multicylinder internal combustion engine. Statistical analysis of the mass emissions data showed significant car and fuel effects on hydrocarbon, carbon monoxide, nitric oxide, total aldehyde, and formaldehyde emission levels and on total photochemical reactivity. Car-fuel interactions were not significant at the 90% level. Correlations were found between mass emission parameters and fuel composition. (Author abstract)

**33972** **APTIC NO. 56321**

Ferguson, E. E.

ATMOSPHERIC METAL ION CHEMISTRY. *Radio Sci., 7(3):397-401, March 1972. 20 refs.*

The role of metal ion chemistry in the atmosphere is reviewed. The available relevant thermal energy binary and three-body reaction rate data are tabulated. The importance of a two step hydration of metal ion is evident. Three-body association of metal ions to carbon dioxide (or possibly oxygen or nitrogen) is followed by a fast binary switching reaction M(+)CO2 + water yields M(+)H2O + CO2 which should be particularly effective for metal ion loss in the D regions. (Author abstract modified)

**33973** **APTIC NO. 56703**

Foote, Christopher S., Ted T. Fujimoto, and Yew C. Chang

CHEMISTRY OF SINGLET OXYGEN. XV. IRRELEVANCE OF AZIDE TRAPPING TO MECHANISM OF THE ENE REACTION. *Tetrahedron Letters, no 1:45-48, 1972. 11 refs.*

The addition of singlet oxygen to olefins to produce allylic hydroperoxides is formally analogous to the Alder Ene reaction. A concerted, cyclic mechanism has been accepted by many workers on the basis of arguments which make unlikely, but do not exclusively rule out a mechanism involving an intermediate perepoxide which opens to product. Recently, the perepoxide mechanism was given support by the observation than added 1 M sodium nitride (NaN3) diverts most of the products of photooxygenation of several olefins to azidohydroperoxides. These new products were interpreted as being formed from the perepoxide by nucleophilic reaction with azide ion. Several experiments were conducted which showed that azidohydroperoxides are formed in a reaction which competes with but is distinct from the normal oxygenation, and that no intermediate formed from singlet oxygen and olefin is common to both reactions. This conclusion was based on the fact that the ratio of normal products to azidohydroperoxides is strongly dependent on sensitizer type and concentration; dyes which are very poor sensitizers for normal photooxygenations produce the largest relative amount of azidohydroperoxide. The NaN3 strongly quenches singlet oxygen; the reaction does not obey the kinetics for the perepoxide trapping scheme. Also, dimethylfuran competitively inhibits the formation of ene products much more than the formation of azidohydroperoxides. The azidohydroperoxides can be formed in a free radical reaction. While the actual mechanism of azidohydroperoxides formation is not completely established, it is clear that the path has nothing to do with the mechanism of the ene reaction. The cyclic mechanism for the ene reaction is the simplest consistent with known facts.

**33974** **APTIC NO. 56704**

Foote, Christopher S., Elaine R. Peterson, and Kyu-Wang Lee

CHEMISTRY OF SINGLET OXYGEN. XVI. LONG LIFETIME OF SINGLET OXYGEN IN CARBON DISULFIDE. *J. Am. Chem. Soc., vol. 94:1032- 1033, 1972. 13 refs.*

Recent studies concluded that neither the rate of reaction of singlet oxygen with substances (k sub a) nor its decay rate (k sub d) vary much in organic solvents. Highly anomalous effects on beta (k sub d/k sub a) in carbon disulfide have been reported for self-sensitized oxygenations of anthracene derivitives; decreases in beta of a factor of 12-60 going from aromatic solvents to CS2 were found. During the present sensitized photooxygenation of anthracene in various solvents, these effects were found to be real and not caused by possible effects of CS2 on any processes in anthracene. The effect of CS2 is to increase the lifetime of singlet oxygen by that order of magnitude compared to benzene or methanol. Although pronounced changes in gamma maximum of anthracene occur, they do not seem to parallel the change in beta, and are probably not related. The shift in gamma is linear with mole % of benzene. The effect of small amounts of added solvents to CS2 could not be accounted for. The effect of CS2 on the lifetime of singlet oxygen could be related to the fact that sulfides form adducts with singlet oxygen.

**33975** **APTIC NO. 56718**

Hindawi, David S.

A STOCHASTIC MODEL FOR CARBON MONOXIDE CONCENTRATIONS ALONG HIGHWAYS AND STREETS. *Calif. Univ., Berkeley, Operations Research Center, National Science Foundation Contract GK 23153, Rept. ORC 72-11, 21p., May 1972. 5 refs.*

NTIS: PB 210209

A mathematical model is presented for the prediction of carbon monoxide concentrations near highways and streets. The CO concentration is treated as a random variable whose distribution function depends on the traffic flow pattern, emission rates of passing cars, and decay effects. Means and variances of CO concentration are computed for two basic traffic flow situations, and bounds on the distribution function are derived under suitable assumption on emission rates. (Author abstract)

**33976** **APTIC NO. 56721**

Ingersoll, R. B.

THE CAPACITY OF THE SOIL AS A NATURAL SINK FOR CARBON MONOXIDE. (FINAL REPORT). *Stanford Research Inst., Menlo Park, Calif., Coordinating*

*Research Council Contract CAPA-4-68 (1-71), Environmental Protection Agency Contract 68-02-0307, SRI Proj. LSU-1380, Rept. EPA-650/2-73-043, 41p., Dec. 1972. 25 refs.*

NTIS: PB 221641

Field studies in which soils were exposed in situ to experimental atmospheres containing carbon monoxide were performed to determine the potential magnitude of North American soils in serving as a sink for atmospheric CO. The uptake of CO by the soils was highly variable, with rates ranging from 7.5-109.0 mg CO/hr/sq m. Tropical soils were generally the most active and desert soils the least active in CO uptake; forest soils were generally more active than grassland soils. Carbon monoxide uptake was greatest at a concentration of 100 ppm and decreased as the concentration decreased. This effect was most pronounced for soils with the slowest uptake rates. Rate of CO uptake by soils under cultivation was significantly less than that of the same soil under natural vegetation, probably a result of a lack of organic matter in the cultivated soils. The uptake rate of soils adjacent to a major highway was greater for soils with a dense surface cover of vegetation than for bare soils. Laboratory studies indicated that soils constantly exposed to high levels of CO had a greater CO uptake rates. Carbon monoxide uptake potentials for soils in the United States and the world were estimated to be 505 million and 14.3 billion tons/yr, respectively. (Author summary modified)

**33977** **APTIC NO. 56387**

Kleymenov, V. I., Yu. V. Chizhov, and F. I. Vilesov

A STUDY OF THE AUTOIONIZATION PROCESSES IN NITRIC OXIDE BY PHOTOELECTRONIC SPECTROSCOPY. *(Issledovanye protessov avtoionizatsii v okisi azota metodom fotoelektronnoy spektroskopii). Text in Russian. Opt. i Spektroskopiya, 34(4):702-708, 1972. 13 refs.*

The results of nitric oxide photoionization are presented. The photoionization was studied by photoelectron spectroscopy at 900 to 1280 A. The energy spectra of electrons released during the photoionization of nitric oxide molecules were obtained for 60 established photon energies. After introducing corrections for the transparency of the electron analyzer and normalization to the intensity of ionizing radiation, the photoelectron spectra were used for determining spectral dependences of partial cross sections of the photoionization transition. The nitric oxide positive ions possessing different vibrational energy reserves were formed in the region of some autoionization bands. The autoionization processes resulted in a strong population of both the low v less than or equal to four and high v less equal to 12 vibrational levels of the nitric oxide positive ion ground state. Large differences between the values of Franck Condon coefficients and ratios of partial cross sections at 1100 to 1350 A are connected with the autoionization processes, the intensity of which exceeds considerably the direct ionization in individual spectral regions. The internuclear distances in excited NO molecules at the autoionization moment were determined for six different autoionization bands. Highly excited autoionization states have, in comparison with the ground NO state, higher equilibrium internuclear distances.

**33978** **APTIC NO. 56664**

Krongauz V. A.

REACTION CAPABILITY OF ELECTRONICALLY EXCITED ORGANICAL MOLECULES. *(Reaktsionnaya sposobnost organicheskikh molekul v elektronno-vozbyzhdennom sostoyanii). Text in Russian. Usp. Khim., 41(5):852-876, 1972.*

A study is made of photochemical ring formation, ring opening reactions, photochemical substitutions in aromatic compounds, the loss of hydrogen in ketones after the photochemical interaction, and the reaction mechanisms, based on literature. After absorbing a quantum of light, the molecule passes to the state of singleton excitement. Direct transfer to the triplet level is usually arrested. The energy of this state is determined by the magnitude of the quantum absorbed and the distribution of levels in the molecule. In the condensed phase, a series of relaxing processes takes place rapidly. The most important process is the spontaneous passing from higher excitement levels to lower ones, and establishing a balanced nuclear configuration in the molecule. The molecule can exist on a lower excitement level for a considerably longer time. Transfer to the basic state is linked with the molecule s deactivation and glowing of redundant energy. The photochemical reactions can take place at any moment after the light absorption by the molecule, and they compete with both the fastest and slowest deactivation processes. The photochemical reactions of cycles formation and breaking are discussed in detail, presenting basic and excited molecular states. Also reactions where orbital symmetry is preserved are presented. The substitution photochemical reactions in aromatic molecules are discussed for phenol, nitrobenzol, p-nitrophenol, m-nitrophenol, and o-nitrophenol. Loss of hydrogen in ketones is discussed. The energy levels of p-aminobenzophenone in izopropanol and cyclohexane are compared. Hydroxibenzophenone reacts in cyclohexane with the quantum output, near to 1. The properties of benzophenone derivatives are presented. Quantum outputs of photofission of the second type in benzole solutions at 25 C and 313 nm are presented.

**33979** **APTIC NO. 56316**

Leesley, M. E. and A. B. Hedley

THE EFFECT OF PARTICLE SIZE DISTRIBUTION ON THE COMBUSTION RATE OF A PULVERIZED ANTHRACITE DUST CLOUD. *J. Inst. Fuel, 45(374):224-230, April 1972. 12 refs.*

The theoretical relation between the combustion rate of a cloud of fuel particles and its particle size distribution parameters are compared with experimental data from combustion of pulverized anthracite at stoichiometric conditions in a one-dimensional furnace. The correlation coefficient is 0.9875 for an equation that relates the particle size and mass flow rates to the O partial pressure and temperature. (Author abstract modified)

**33980** **APTIC NO. 56662**

Marrero, T. R. and E. A. Mason

GASEOUS DIFFUSION COEFFICIENTS. *J. Phys. Chem. Ref. Data, 1(1):3-118, 1972. 596 refs.*

Diffusion coefficients of binary mixtures of dilute gases are comprehensively compiled, critically evaluated, and correlated by new semi-empirical expressions. There are 74 systems for which the data are sufficiently extensive, consistent, and accurate to allow diffusion coefficients to be recommended with confidence. Deviation plots are given for most of these systems. Almost every gaseous diffusion coefficient which was experimentally determined and reported prior to 1970 can be obtained from the annotated bibliography and table of gas pairs. A detailed analysis of experimental methods is given, and intercomparison of their results helps establish reliability limits for the data, which depend strongly on temperature. Direct measurements are supplemented by calculations based on knowledge of intermolecular forces derived from independent sources molecular beam scattering for high temperatures and London dispersion constants for low temperatures. In addition, diffusion coefficients for several mixtures are obtained from experimental data on mixture viscosities and thermal diffusion factors. Combination of all these results gives diffusion coefficients over a very extensive temperature range, from very low temperatures to 10,000 K. All data are corrected for composition dependence and for quantum effects. New semi empirical equations are derived for making such corrections easily. (Author abstract)

**33981** **APTIC NO. 56399**

Pozdnyakov, D. V. and V. N. Filimonov

INFRARED SPECTRA OF CARBON MONOXIDE CHEMISORBED ON HYDROXYL-COATED AND DEHYDROXYLATED SURFACES OF SOME METAL OXIDES. *(Infrakrasyye snektry okisi ugleroda khemosorkirovannoy napokrytoy gidroksilami i degidroksilirovapnoy noverkh nosti nekotorykh okislov metallov. Text in Russian. Zh. Fiz. Khim., 46(4):1011-1012, 1972. 8 refs.*

The infrared spectra of carbon monoxide chemisorbed on hydroxyl-coated and dehydroxylated surfaces of some metal oxides was determined. At temperatures greater than 250 C, CO is chemisorbed on dehydroxylated metal oxides in the form of carbonates which gives rise to the appearance of absorption bands at 1300 and 1650 cm to the -1st power in zirconium oxide, hafnium oxide, and magnesium oxide spectra, and bands at 1450 and 1550 cm to the -1st power in aluminum oxide. On the surfaces coated with hydroxyl groups, absorption bands at 1330-1440, 1550-1610, and 2800-2930 cm to the -1st power reveal the formation of formates.

## 1971

**33982** **APTIC NO. 56647**

Caretto, Laurence S. and Robert F. Sawyer

COMBUSTION THERMODYNAMICS. *In: Combustion-Generated Air Pollution, A Short Course on Combustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 3-37. 38 refs.*

Basic considerations of combustion are presented based on the assumption of the attainment of thermodynamic equilibrium in the combustion process. A review is presented of the laws of thermodynamics, the concepts of enthalpy and internal energy, Helmholtz and Gibbs functions, mixtures, composition change, stoichiometry, thermochemistry, reactants and reaction products, and complex equilibria; and the effects of such thermodynamic variables as equivalence ratio, temperature, and pressure on equilibrium compositions are examined. The model proposed is useful and valid in predicting the energy release, flame temperature, and limiting composition of combustion product mixtures. An improved understanding of combustion is viewed as likely to result from air pollution problems.

**33983** **APTIC NO. 56446**

Ciba, Jerzy, Zbigniew Gregorowicz, and Henryk Stec

A RAPID METHOD FOR DETERMINING SULPHUR IN NAPHTHALENE AND COAL TAR DERIVATIVES. *(Szybki sposob oznaczania siarki w naftalenie i produktach weglopochodnych). Text in Polish. Koks, Smola, Gaz, 16(11):312-314, 1971.*

A rapid method was devised by scientists at the Silesian Politechnic for determining sulfur in naphthalene and coal tar derivatives. The sample was combusted in oxygen under pressure in a 300 cu cm KL-3 bomb calorimeter. The combustion products, among them sulfur dioxide, were absorbed in a hydrogen peroxide solution, and the sulfate ions were determined conductometrically. Optimum conditions of combustion, absorption, and titration were determined. Quartz containers were used instead of metallic crucibles. The conductometer was of the OK-102 Radelkis type (Hungarian). The presence of sodium ions disturbed the proper course of the conductometric determination. The sulfur oxides were absorbed satisfactorily in the hydrogen peroxide solution. Best results were obtained for samples which contained acetone or methane in a 1:1 proportion. The method described is superior to the Grothe Krekeler method. For small quantities of sulfur in samples, the polarographic or spectrophotometric methods can be used for determining sulfur ions instead of the conductometric determination.

**33984** **APTIC NO. 56701**

Foote, Christopher and Robert W. Denny

CHEMISTRY OF SINGLET OXYGEN. XIII. SOLVENT EFFECTS ON THE REACTION WITH OLEFINS. *J. Am. Chem. Soc., vol. 93:5168-5171, Oct. 6, 1971. 44 refs.*

Solvent effects on the product-forming step of the dye-sensitized photooxygenation of 2-methyl-2-pentene were measured to provide further information on the transition state. The variation in beta (ratio of the decay rate of singlet oxygen to its rate of reaction) was very small, amounting to less than a factor of four in the solvents studied. No effect of solvent polarity, internal pressure, viscosity, or heavy atoms could be discerned. The results of these studies and those previously reported are consistent with a concerted reaction mechanism involving a six-center transition state, but do not completely exclude a perepoxide intermediate. (Author abstract modified)

**33985** **APTIC NO. 56700**

Foote, Christopher S. and Robert W. Denny

CHEMISTRY OF SINGLET OXYGEN. XII. ELECTRONIC EFFECTS ON RATE AND PRODUCTS OF THE REACTION WITH OLEFINS. *J. Am. Chem. Soc., vol. 93:5162-5167, Oct. 6, 1971. 26 refs.*

Singlet excited molecular oxygen, almost certainly in the 1 delta g state, is the reactive intermediate in the dye sensitized photooxygenations of olefins and polyenes. The sensitivity of the reaction to electronic effects was studied, and conclusions were drawn regarding the transition state for the reaction between singlet oxygen and olefins. The rates and products of photo and hypochlorite-hydrogen peroxide oxygenations of ring-substituted alpha,beta,beta-trimethylstyrenes were determined. The rates of both reactions correlated with sigma (rho equals -0.92). The product in each case was a mixture of the 2-methyl-3-phenyl-3-butene-2-ol in an invariant ratio of about 2.7:1. Epoxidation of the same olefins proceeded with a rho of -0.87 when the best-fit value of delta r+ (fraction of rho+) of 0.37 was used. The singlet oxygen oxygenation was mildly electrophilic, but sensitive mainly to inductive effects, and neither charge nor radical character was localized in the transition state. The product ratio did not appear to be sterically determined. (Author abstract modified)

**33986** **APTIC NO. 56702**

Foote, Christopher S. and John W. Peters

CHEMISTRY OF SINGLET OXYGEN. XIV. A REACTIVE INTERMEDIATE IN SULFIDE PHOTOOXIDATION. *J. Am. Chem. Soc., vol. 93:3795-3796, July 28, 1971. 7 refs.*

Dialkyl sulfides undergo sensitized photooxidation to give sulfoxides in a smooth reaction with overall stoichiometry involving singlet oxygen. The reaction proceeds efficiently in methanol but very inefficiently in benzene. In benzene, kinetic analysis shows that over 95% of the reactions of singlet oxygen with diethyl sulfide result in quenching, and only a few percent lead to sulfoxide. No quenching occurs in methanol. An attractive formulation for the reaction involves the intermediacy of an oxidizing species which might be the zwitterion (persulfoxide), the diradical, or possibly the cyclic peroxide. The unstable reactive intermediate was verified experimentally. It was tentatively assigned the persulfoxide structure. The evidence for the intermediate is based on trapping, intramolecular reaction, and solvent effect. The evidence does not rule out the possibility that quenching is an entirely separate pathway such as an electron-transfer process.

**33987** **APTIC NO. 56381**

Fuchs, David

FACTORS TO CONSIDER IN THE DECISION TO AUTOMATE UNIT AND ENVIRONMENTAL TESTING. *Inst. of Environmental Sciences, Mt. Prospect, Ill., Proc. Inst. Environ. Sci., Annu. Tech. Meet., 17th, Los Angeles, Calif., 1971, p. 463-468. (April 26-30.)*

The requirements and benefits of automated unit and environmental testing are described. Automation can significantly reduce the cost of hardware and manpower; increase the efficiency of operation by providing more meaningful and accurate data, and by providing both intermediate and final results sooner; and provide a simplicity of operation by allowing software to perform the test function, thereby permitting significantly less complex hardware to provide the function of interfacing, rather than complete testing. The requirements for developing an on-line test program for a typical unit are tabulated and require 26 man-hours of programming. The annual cost for staff is estimated at $550,000 and for hardware and time at $3,700,000. The total potential annual savings for an automated system is $1,950,000.

**33988** **APTIC NO. 56430**

Jessup, Artie D.

LYOPHILIZED SPORE DISPENSER. *(National Aeronautics and Space Administration, Cambridge, Mass., Langley Research Center) U. S. Pat. Appl. 198,928. 9p., Oct. 13, 1971. (claims not given).*

A lyophilized spore dispenser for dispensing a finely dispersed, monoparticulate cloud or spray of bacterial spores is described. The spores are contained within a tightly sealed chamber and a turbulator orifice connected to an air supply source provides a jet of air which stirs up the spores and causes the spores to be suspended in eddy currents within the chamber. The air jet produces a positive pressure within the chambers which forces the spores out of an injection orifice. The provision of a spore dispenser to produce a monoparticulate spray of lyophilized spores and the use of a gas jet to get the dried spores airborne while at the same time providing the necessary positive pressure for injection of the spores thorugh an outlet orifice are unique. (Author abstract modified)

**33989** **APTIC NO. 56398**

Peddieson, John, Jr.

AN INVESTIGATION OF THE OSEEN EQUATIONS FOR A SOLID-FLUID SUSPENSION. *Inst. of Environmental Sciences, Mt. Pleasant, Ill., Proc. Inst. Environ. Sci., Annu. Tech. Meet., 17th, Los Angeles, Calif., 1971, p. 23-27. 10 refs. (April 26-30.)*

A linearization scheme is proposed and applied to the boundary layer equations for a solid-fluid suspension. Two problems were solved within the context of the linearized equations, and in both cases the solutions preserved the qualitative features of known solutions to the exact equations. This indicates that the linearized equations represent a valid mathematical model for the exact equations. They should provide a useful vehicle for testing the accuracy of various approximation procedures such as local similarity, series truncation, and momentum integral analysis. The linearized equations should also be useful in determining the qualitative features of complex flow fields. (Author abstract modified)

**33990** **APTIC NO. 56648**

Sawyer, Robert F.

COMBUSTION RATES. *In: Combustion-Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution Held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 39-66. 8 refs.*

Combustion rates are examined in order to lend insight on determining whether or not the combustion will go to completion (equilibrium) and on the controlling factors on the composition of combustion products. Some of the most vexing problems of air pollution arising from combustion processes are those resulting from the failure to obtain equilibrium conditions; and concentration levels of hydrocarbons, carbon monoxide, and nitric oxide emitted from combustors characteristically exceed the predicted equilibrium values for the exit conditions. Parameters which have been identified as affecting combustion rates include: pressure, temperature, thermal diffusivity, molecular diffusivity, chemical reaction rate, and turbulence level. The principle effect of pressure is to change the thickness of the flame zone or loading of a stirred reactor, while temperature affects the combustion rate primarily through the exponential dependence of reaction rate upon temperature. Transport properties generally are not available as controllable system parameters which may be adjusted for their effect on combustion rate. Chemical reaction rate does not control the combustion rate in diffusion flames, although it does play a primary role in determining the combustion rate in premixed flames. High levels of turbulence greatly accelerate combustion rates, and industrial combustors are designed to operate under turbulent conditions. The burning rate of a droplet in a turbulent flow may, however, be controlled by the diffusion rates in the local laminar flame zone surrounding the individual droplet. (Author summary modified)

**33991** **APTIC NO. 56311**

Tuteja, A. D. and H. K. Newhall

NITRIC OXIDE FORMATION IN LAMINAR DIFFUSION FLAMES. *General Motors Research Labs., Proc. Emissions Continuous Combust. Syst., 1971, p. 109-121, 1972. 14 refs.*

A vertical coaxial burner was used to study nitric oxide formation in diffusion flames. Localized combustion gas samples extracted from the diffusion flame by means of quartz microprobe were analyzed for No as well as for carbon monoxide, carbon dioxide, nitrogen, oxygen, and methane, the fuel employed. It was thereby possible to establish detailed radial profiles for each of these species. Concomitant temperature profiles were established through the use of a 0.001 in. diameter Pt/Pt-10%Rh thermocouple. The experimental results indicate that in diffusion flames of this type, NO formation occurs in a narrow region corresponding to that of maximum temperature. It is of particular interest that so-called prompt NO formation within the highly active flame zone is not observed. (Author abstract)

**33992** **APTIC NO. 56374**

Washington, Warren M.

ON THE POSSIBLE USES OF GLOBAL ATMOSPHERIC MODELS FOR THE STUDY OF AIR AND THERMAL POLLUTION. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 18, p. 265-276. 7 refs. (Also: Workshops on Research Problems in Air and Water Pollution, Boulder, Colo., Aug. 3-15, 1970.)*

The construction of a computer model of the earth s atmosphere is discussed, along with its application for future air pollution experiments. The basic equations used in constructing the model are the hydrodynamic and thermodynamic laws for a gas or fluid system: their solution yields the time evolution of the meteorological variables such as temperature and pressure as a function of space. The model must also take into account atmospheric heating and cooling sources and possible means by which air pollution can affect the heating and cooling processes. To determine what would happen to the climatology if an additional ground heat source (thermal pollution) were added to the continental areas, a model which simulates the month of January was used.

## 1970

**33993** **APTIC NO. 56717**

Eberhardt, L. L.

SOME BIOMETRIC ASPECTS OF POLLUTION PROBLEMS. *Proc. Symp. Develop. Implement. Courses Curric. Nat. Resource, Biom., W. E. Frayer (ed.), p. 178-189, 1970. 24 refs.*

Some biometric aspects of pollution problems are presented, and the urgent requirement for some kind of framework for research or survey design is underlined. System identification, identifying a workable set of equations, and system description, estimating the parameters therein and testing the validity of the model, are viewed as the two major needs of biometry. Sampling of the system requires dealing with components of the biota and substrate in addition to coordinates of time and space. Choice of a species list for sampling may perhaps best be predicated on the objectives of the study. Concern with hazards to man or to certain economically or ecologically important species may in some cases lead to the selection of a reduced list of key species, and the selection of such a list may often require a much better knowledge of ecosystem dynamics than presently available. Workable first order kinetic models are also needed at present. Biomedical compartment-model analysis is directly applicable where emphasis is on the fate of contaminants in an individual organism, but such models are compounded by transfer considerations when ont turns to field studies. Sampling and analysis of data require the estimation of the biomass of the species considered if objectives of a given study are taken to be the estimation of total quantities of a contaminant. Presently, the main contribution towards analysis of field data may have to come from the study of residuals around fitted models: the routine application of standard analysis-of-variance techniques should not be encouraged. The major problem in regard to sampling appears to be one of what to say about allocation -- in time, space, and by species. Field studies also present troubles in assessing biological effects of pollutants.

**33994** **APTIC NO. 56699**

Mazur, Stephen and Christopher S. Foote

CHEMISTRY OF SINGLET OXYGEN. IX. A STABLE DIOXETANE FROM PHOTOOXYGENATION OF TETRAMETHOXYETHYLENE. *J. Am. Chem. Soc., vol. 92:3225-3226, 1970. 20 refs.*

The possibility that 1,2-dioxetane is an intermediate in chemiluminescent reactions and in olefin photooxygenations is discussed. The reactive olefin 1,1,2,2-tetramethoxyethylene was photooxygenated in ether at -70 deg. Both sensitization by zinc tetraphenylporphine or dinaphthalenethiophene and sensitization by visible light were essential. The resultant product was consistent with dioxetane 1,2-dioxa-3,3-4,4-tetramethoxycyclobutane structure. This represents the first preparation of a 1,2-dioxetane by photooxygenation, but by no means requires that 1,2 cycloaddition of singlet oxygen be concerted, in particular, dipolar ions may well be intermediate. These experiments do not provide evidence either for or against the assertion that dioxetanes may be intermediate in the formation of allylic hydroperoxides in the ene-type photooxygenation.

**33995** **APTIC NO. 56722**

Stoeber, Werner

SMOKE AEROSOLS (FORMATION, CHANGE, FILTRATION). *Proc. Int. Congr., 5th, Tobacco Sci., Hamburg (West Germany), 1970, p. 219-224. 16 refs.*

Fundamental concepts of physical chemistry as involved in the formation, change, and filtration of smoke aerosols are presented. Problems of autonucleation and condensation on foreign nuclei are considered, starting from single-component systems as simple models for the demonstration of various phenomena occurring in a disperse two-phase system. Smoke particle studies with cigarettes indicate that the particles will not deviate extensively from a mean particle size for two reasons. First, the rapid temperature drop causes almost simultaneous growth on all nuclei available, generally leading to the formation of quasi-monodisperse droplet aerosols; and secondly, the fitration process by the tobacco strands and the filter tip of the cigarette will have a minimum efficiency somewhere in the size range .00001 cm, with particles of substantially smaller or bigger size being captured. The initial particulate number concentration of cigarette smoke has been measured, and values between 1.7 and 5.3 times to to the 9 particles/cu cm have been reported with coagulation constants between 2.4 and 4.5 times 10 to the minus 10 cu cm/sec. Mass concentration of the smoke droplets varied between less than 1 mg to over 5 mg/puff. No reliable data exist describing the chemical composition of smoke droplets of different sizes in tobacco smoke. (Author abstract modified)

## 1969

**33996** **APTIC NO. 56358**

Bufalini, J. J. and K. L. Brubaker

THE PHOTOOXIDATION OF FORMALDEHYDE AT LOW PARTIAL PRESSURES. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 225-240. 30 refs.*

Photooxidation of formaldehyde at low partial pressures resulted in the production of hydrogen peroxide. The molecular imbalance between peroxide formed and formaldehyde consumed was explained by radical decomposition and surface effects. No other oxidants were produced. Hydrogen peroxide yield was lowered and ozone was formed when formaldehyde was irradiated in the presence of nitrogen dioxide. The carbon fragments appeared mostly as carbon monoxide and carbon dioxide; little if any formic acid was produced. (Author abstract modified)

**33997** **APTIC NO. 56356**

Cadle, R. D. and E. R. Allen

REACTIONS OF O(3P) WITH ALDEHYDES IN PHOTOCHEMICAL SMOG. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 63-87. 36 refs.*

A laboratory study was made of the kinetics and products of the reaction of O(3P) with acetaldehyde, propionaldehyde, and acrolein using both fast-flow and static methods. A comparison of the rate constants with the effectiveness of the aldehydes in accelerating the oxidation of nitric oxide to nitrogen dioxide suggests that the aldehydes are much more effective as producers of smog than the rates of reaction with atomic oxygen might indicate. Hence, their role in smog formation may be much more involved than merely to produce highly reactive species by reaction with atomic oxygen. Oxygen, NO, carbon dioxide, methyl nitrate, and nitromethane were produced when NO2-acetaldehyde mixtures were photolyzed at 3660 A. Peroxyacetyl nitrate was also produced when oxygen was added to the mixture. (Author abstract modified)

**33998** **APTIC NO. 56350**

Calvert, Jack G., David H. Slater, and James W. Gall

THE METHYL RADICAL-SULFUR DIOXIDE REACTION. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 133-158. 24 refs.*

Methyl radical addition to sulfur dioxide was studied in an effort to investigate potential SO2 removal paths in the atmosphere. Methyl radicals add readily to sulfur dioxide, though an apparent second-order rate constant showed an anomalous temperature dependence for which a firm explanation was not possible. Methyl sulfur dioxide radicals readily add to the double bond in azomethane. The demonstrated enhancement of aerosol formation by the presence of sulfur dioxide in photochemical smog-producing atmospheres may be initiated by radical addition to sulfur dioxide and subsequent addition of RSO2, ROSO2, or RO2SO2 radicals to olefin molecules in the polluted atmosphere. (Author conclusions modified)

**33999** **APTIC NO. 56357**

Dimitriades, B. and M. L. Whisman

ALDEHYDE-OLEFIN INTERACTION IN THE NITROGEN OXIDE-SENSITIZED PHOTOOXIDATION OF ALIPHATIC OLEFINS. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 89-101. 7 refs.*

The possibility of olefin-aldehyde interactions occurring in nitrogen oxide-sensitized photooxidation of 1-butene-aldehyde mixtures was investigated. Consumption of CH2:CHCH2CH3 was found to be affected by the presence and nature of other hydrocarbons and/or aldehydes. Further investigation revealed that the effects of aldehydes on CH2:CHCH2CH3 consumption could be explained in terms of effects on oxygen atom and ozone concentrations only during the later reaction stage following photooxidation of nitric oxide to nitrogen dioxide. Aldehyde effects in the earlier stages can be explained only if olefin radical reactions occur in parallel with the olefin-O atom reaction. (Author abstract modified)

**34000** **APTIC NO. 56798**

Golden, David M. and Sidney W. Benson

FREE-RADICAL AND MOLECULE THERMOCHEMISTRY FROM STUDIES OF GAS- PHASE IODINE-ATOM REACTIONS. *Chem. Rev., vol. 69:125-134, 1969. 45 refs.*

The utility of gas-phase reactions of both aliphatic and aromatic iodides with hydrogen iodide which go quantitatively to the parent hydrocarbon and iodine at measurable rates in the 200 500 C temperature range is reviewed in relation to kinetic and thermodynamic studies of free-radical reactions. System that have been studied include the positional and geometrical isomerizations of various olefins. Results obtained have led to accurate values of the differences in enthalpy and entropy between isomers and have been combined with an independent value to obtain heats and entropies for a whole set of isomers. Pyrolyses of organic iodides take place through simple eliminations and through atom and radical processes discussed in the text.

**34001** **APTIC NO. 56359**

Groblicki, P. J. and G. J. Nebel

THE PHOTOCHEMICAL FORMATION OF AEROSOLS IN URBAN ATMOSPHERES. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 241-267. 26 refs.*

Photochemical reactions involving gaseous contaminants of urban atmospheres such as various hydrocarbons, sulfur dioxide, nitric oxide, and ozone were investigated in a large irradiation chamber to study the photochemical formation of aerosols. The amount of aerosol formed in irradiation of the HC-NO-SO2 system depended on the nature of the HC as well as the concentration. Alpha pinene and cyclohexene formed the most aerosol, and ethylene the least. The aerosol formed from all HC except C6H10 and C10H16 was predominantly ammonium sulfate; C6H10 and C10H16 formed aerosols which contained carbonaceous material as well as Al2(SO4)3. These two HC, unlike the others investigated, produced as much aerosol when irradiated with NO alone as when irradiated with NO and SO2; they also produced appreciable aerosol when reacted with O3 in the dark. Although only minor amounts of aerosol were formed by the dark reaction of SO2 and O3, significant aerosol was formed when propylene was also present. Two distinct types of aerosol can be formed by some of the gaseous contaminants of urban atmospheres. Ozone appears to be the key reactant in the formation of both types, and irradiation and NO may be involved only to the degree that they form O3. (Author abstract modified)

**34002** **APTIC NO. 56352**

Heicklen, Julian, William P. Wood, Kenneth J. Olszyna, and Edwin Cehelnik

THE REACTIONS OF UNSTABLE INTERMEDIATES IN THE OXIDATION OF CS2. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 191-222. 24 refs.*

The photooxidation of carbon disulfide was studied with radiation at 3130 A in a conventional static photochemical system at room temperature. The reactant pressures varied from 2-70 torr of CS2 and from 1-745 torr of oxygen. Absorbed light intensity varied from 2.0-111 micron/min. The products of the reaction were carbon monoxide, carbonyl sulfide, sulfur dioxide, and a polymer; carbon dioxide and sulfur trioxide were not produced. Only the polymer was formed in the absence of O2, but in smaller amounts. The quantum yields of the gaseous products were small and typically ranged from 3 times .0001 to .1. The ratios of the products were invariant for all runs despite significant variations in the quantum yields. A carbon-sulfur mass balance was indicated among the gaseous products. Product quantum yields depended only on (O2)/(CS2); otherwise they were invariant to changes in (O2), (CS2), or absorbed light intensity. A mechanism is proposed for the results. (Author abstract modified)

**34003** **APTIC NO. 56355**

Jaffe, Sigmund

SOME REACTIONS OF NITROGEN DIOXIDE WITH OLEFINS. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 103-130. 23 refs.*

Linear free energy correlations between nitrogen dioxide rate constants and ozone and oxygen atom rate constants for a selected set of olefins yielded reasonably straight lines, supporting the contention that the rate-controlling steps in the three systems have some common elements. The rate laws in all cases were first-order in both NO2 and the olefin. Mechanically, NO2 was postulated to add to ethylene, forming an intermediate that rearranges to yield excited acetaldehyde or ethylene oxide plus nitric oxide. Reaction of the aldehyde or oxide with NO2 gave rise to free radicals which may account for the products found upon further reaction with NO2. Reaction enthalpy for the aldehyde was -38 kcal/mole, while that for the oxide was -11. The rate law derived from this mechanism agreed with second-order kinetics found experimentally. The mechanism also explained the formation of NO, carbon dioxide, nitrous oxide, water, nitromethane, methynitrate, ethylene oxide, and acetaldehyde, which were found by chromatographic analysis. Results of quantum yield measurements for the loss of NO2 in the photooxidation of the representative set of olefins are presented; and related thermal and photochemical reactions of NO2 with ethylene oxide acetaldehyde, acetone, and propionaldehyde are discussed. (Author abstract modified)

**34004** **APTIC NO. 56353**

Stephens, Edgar R.

HYDROCARBON REACTIVITIES AND NITRIC OXIDE CONVERSION IN REAL ATMOSPHERES. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 45-59. 22 refs.*

Studies concerning the analysis and irradiation of ambient air indicate that a reaction equivalent to 8 or 10 hr of irradiation can occur, and that during such an interval even the saturated hydrocarbons, which are generally of low reactivity, can make a significant contribution to the total reaction because of their generally larger quantities. Attack by ozone, although it might account for loss of olefins, cannot account for the observed loss rate of paraffins; and attack by oxygen atoms cannot, on the basis of literature rate constants, account for the loss rate of either class of hydrocarbons. Another striking feature of these studies is that quite small amounts of hydrocarbon reacted are necessary to cause conversion of nitric oxide to nitrogen dioxide and the development of smog symptoms. A chain reaction is believed to drive NO to NO2; a reaction of oxygen atoms with propylene in the presence of NO is postulated which eventually forms hydroxyl radicals for driving the system. (Author abstract modified)

**34005** **APTIC NO. 56351**

Timmons, Richard B., Henry F. LeFevre, and Gerald A. Hollinden

REACTIONS OF SULFUR DIOXIDE OF POSSIBLE ATMOSPHERIC SIGNIFICANCE. *General Motors Research Labs., Warren, Mich., Chem. React. Urban Atmos., Proc. Symp., Warren, Mich., 1969, p. 159-190. 41 refs.*

The reactions of electronically excited sulfur dioxide molecules with hydrocarbons and carbon monoxide were investigated. Quantum yields for SO2 consumption were generally very low, ranging from less than 0.010 for methane to 0.080 for n-butane. The quantum yield for the oxidation of CO to carbon dioxide by excited SO2 was also very low, being 0.005 under conditions of equal pressures of SO2 and CO. A general mechanism was proposed from the observed quantum yields and their pressure dependence whereby the reactions of SO2 arise from the triplet SO2 excited state. Susceptibility of SO2 toward attack by carbon trifluoride radicals and oxygen atoms was also investigated; the CF3 radicals were generated by the photolysis of hexafluoroacetone. Addition of SO2 resulted in a net scavenging of CF3 radicals at temperatures below 65 C. A value of 15 + or 5 kcal/mole was determined for the C-S bond energy in the CF3SO2 radical from the observed temperature dependence of the SO2 scavenging. The reaction of O atoms with SO2 was investigated using electron spin resonance and was shown to be a termolecular process. The specific rate constant for the reaction was found to be 4.1 times 10 to the 16 cm to the 6/mole sec. The reaction rate was slower by a factor of 40 when helium or argon was the inert gas. An activation energy of 3.43 kcal/mole was obtained. (Author abstract modified)

## 1968

**34006** **APTIC NO. 56797**

Furuyama, Shozo, David M. Golden, and Sidney W. Benson

THE THERMOCHEMISTRY OF THE GAS-PHASE EQUILIBRIA TRANS-1,2- DIIODOETHYLENE REVERSIBLE REACTION ACETYLENE PLUS I2 AND TRANS-1,2-DIIODOETHYLENE REVERSIBLE REACTION CIS-1,2- DIIODOETHYLENE. *J. Phys. Chem., 72(9):3204-3208, Sept. 1968. 12 refs.*

The equilibrium concentrations of 1,2-diiodoethylene, iodine, and acetylene were determined in the gas phase from 234.5 to 409.4 K by spectrophotometric techniques in situ; and the ratio of cis to trans-diiodoethylene was determined from nmr spectra of the separated diiodoethylene. These, when combined with the known entropies, yielded the following enthalpy values (298 K): for trans-1,2-diiodoethylene, 49.2 plus or minus 0.1 kcal/mol and for cis-1,2-diiodoethylene 49.2 plus or minus 0.1 kcal/mol. Values of the contributions to the group Cd-(I)(H) were: delta H equal to 24.6 kcal/mol and entropy equal to 40.5 gibbs/mol (cis correction delta H equal to zero and S equal to 1.1 gibbs/mol). Absorption coefficients (OD/M cm) for both cis and trans-diiodoethylene as well as for the equilibrated mixture were measured at 239, 252, and 285 micron and were independent of temperature. (Author abstract modified)

**34007** **APTIC NO. 56799**

Lee, E. Stanley

INVARIANT IMBEDDING, NONLINEAR FILTERING, AND PARAMETER ESTIMATION. *Ind. Eng. Chem. Fundamentals, 7(1):164-171, Feb. 1968. 7 refs.*

The invariant imbedding concept was used to derive sequential estimator equations in the theory of nonlinear filtering and estimation. Numerical experiments were performed on a digital computer to test the estimator equations which were used to obtain the reaction rate constant and the concentration of reactant for a chemical reaction scheme occurring in a batch reactor. The invariant imbedding approach appears to be an effective tool to treat nonlinear estimation problems, although more computational experiments on more complex problems are needed.

**34008** **APTIC NO. 56800**

Lee, E. Stanley

QUASILINEARIZATION AND THE ESTIMATION OF PARAMETERS IN DIFFERENTIAL EQUATIONS. *Ind. Eng. Chem. Fundamentals, 7(1):152- 158, Feb. 1968. 8 refs.*

A mathematical method of parameter estimation, treated as a two- point or multi-point boundary-value problem, is presented. The approach is especially suited for on-line updating of parameters of a computer-controlled process and for the estimation of chemical reaction rate constants for raw kinetic data with certain assumed or known mechanisms of reaction. A chemical reaction occurring in a homogeneous tubular flow chemical reactor with axial mixing is considered to illustrate the approach, and the resulting set of differential equations of boundary-value type is solved by the quasilinearization technique. Although the examples are based upon data which do not contain any noise, the technique can be extended to experimental data with noise and measurement errors.

## 1967

**34009** **APTIC NO. 56332**

Block, Arthur McBride

SCATTERING OF LASER LIGHT BY UNIFORM SPHERICAL PARTICLES. *Rutgers-The State Univ., New Brunswick, N. J., Dept. of Physical Chemistry, Thesis (Ph.D), Ann Arbor, Mich., Univ. Microfilms, Inc., 1967, 144p. 55 refs.*

Uniform spherical particle sols of Dow polystyrene latex were used to test the Mie theory of diffraction of monochromatic radiation by a sphere. Sol particles whose diameters were 0.557 micron, 0.714 micron, and 1.099 micron gave Mie parameters, alpha, of 3.68, 4.74, and 7.27, respectively, for experiments carried out with a neon helium laser oscillating at 6328. The angular scattering function of extremely dilute sols was measured with the incident radiation polarized so that its E vector was perpendicular to the plane of scattering. Data are presented as the intensity of scattered light between angles of 40 deg and 120 deg divided by the intensity scattered at 40 deg. Data points are shown superimposed on theoretical curves corrected for back reflection. Extinction measurements were carried out on the three sol sizes mentioned using the 6328 neon helium laser. The total scattering coefficient was calculated from the extinction. In all three sols studied, the experimentally derived total scattering coefficient was within 10% of the value predicted by the Mie theory. Details of design and alignment of the laser source angular measurement device and detection system used to make the measurements are included. (Author abstract modified)

# EFFECTS-HUMAN HEALTH

## 1973

**34010** **APTIC NO. 56689**

Anbar, M., R. L. Dyer, and G. A. St. John

DETERMINATION OF NITRIC OXIDE IN BLOOD BY ISOTOPE DILUTION ANALYSIS. *Agronne National Lab., Argonne, Ill., Proc. First Int. Conf. Stable Isotopes Chem. Biol. Med., Argonne, Ill., 1973, p. 452-459. 11 refs. (May 9-11.)*

NTIS: CONF-730525

Nitric oxide binds to hemoglobin many times stronger than carbon monoxide. There is a discrepancy between the expected binding of NO to Hb in vivo and the failure to detect the characteristic HbNO optical absorption band. However, the isotope dilution technique can be used to determine NO in blood. The blood of six humans was analyzed for NO content by the isotope dilution analysis using field ionization mass spectrometry. Instrumentation and precision of the method are described. The average NO content was about 20 nanomoles/ml whole blood, corresponding to about 0.25% saturation of Hb with NO. No correlation was found between smoking habits and NO content. Since rats showed less than 1 nanomole/ml blood of NO, i.e., below the sensitivity of detection, the possibility exists of fast metabolization of NO in rats. The action of NO and nitrogen dioxide on rats and humans is speculated on.

**34011** **APTIC NO. 56894**

Beck, E. G., N. Manojlovic, and Anna B. Fischer

COMPARATIVE STUDIES ON THE CYTOTOXICITY OF ATMOSPHERIC FINE DUST. *(Vergleichende Untersuchungen ueber die Zelltoxizitaet atmosphaerischer Schwebestaeube). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A3-A6. 9 refs.*

The cytotoxicity of fine dusts collected in industrial and rural areas in West Germany was studied in alveolar macrophage cultures from guinea pigs. Atmospheric fine dust proved to be cytotoxic in varying degrees, depending on the time and site of dust collection. Pronounced vacuolization in 3 hr, a change in the cell permeability in 5 hr, and, due to certain dusts, loss of motility in 20 hr incubation were observed. Benzo(a)pyrene, lead, and fibrous dusts such as asbestos fibers were found to be the major dust components responsible for the cytotoxicity of the dust sampled in industrial areas. Separation of benzo(a)pyrene from fine dust particles, and metabolization by alveolar macrophages was observed. The metabolism of benzo(a)pyrene was inhibited by other toxic components in dust samples from industrial areas. Rapid lysis, and protracted vacuolization due to intracellular dissolved lead were observed. The partial phagocytosis of long asbestos and glass fibers led to localized cell permeation, compensation for the loss of enzymes, and metabolic changes, manifesting themselves in increased lactate formation. The interaction between the cell and the partially incorporated fibers constitutes a permanent irritation, a characteristic feature in etiology of asbestosis and tumor formation.

**34012** **APTIC NO. 56537**

Canella, Durval J.

PB AND CO EFFECTS ON OFFICE PERSONNEL OF NARROW STREETS WITH INTENSIVE TRAFFIC. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A56-A58. 13 refs.*

Analysis of lead, carbon monoxide, and carboxyhemoglobin from indoor environments and personnel located in offices situated in narrow streets with heavy traffic was performed. All of the results differed greatly, with the exception of values found for one location. The amount of concentration decreased as collecting time increased, and no reasonable explanation was found for this fact. Concentration of lead in the bloodstream was not proportional to the concentration found in the atmosphere, whereas results observed for carbon monoxide and carboxyhemoglobin were more consistent. There was a greater incidence of carboxyhemoglobin for higher concentrations of CO. Values for Pb and CO concentration found in the atmospheric samples did not reach the threshold limit values adopted by the American Conference of Governmental Industrial Hygienists.

**34013** **APTIC NO. 56889**

Carter, V. L., Jr., G. W. Schultz, L. L. Lizotte, E. S. Harris, and W. E. Feddersen

THE EFFECTS OF CARBON MONOXIDE-CARBON DIOXIDE MIXTURES ON OPERANT BEHAVIOR IN THE RAT. *Toxicol. Appl. Pharmacol., 26(2):282-287, Oct. 1973. 10 refs.*

Ten rats conditioned to a positive reinforced FR-15 bar press task were exposed to 1000 ppm carbon monoxide; 2.5%, 5.0%, and 7.5% carbon dioxide; and CO-CO2 mixtures. The CO reduced the bar press responses from a mean of 90.44/min to 3.89/min. The CO2 in concentrations of 2.5, 5.0, and 7.5% in the presence of 1000 ppm CO increased the rats performance to means of 16.74/min, 41.94/min, and 44.50/min, respectively. The CO2 concentrations as high as 7.5% alone had little effect on the operant response. Thus, CO2 can partially antagonize the central nervous system depressant effects of CO. (Author abstract)

**34014** **APTIC NO. 56854**

Erlich, Richard and J. D. Fenters

INFLUENCE OF NITROGEN DIOXIDE ON EXPERIMENTAL INFLUENZA IN SQUIRREL MONKEYS. *Proc. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A11-A13. 7 refs.*

To further study nitrogen dioxide-induced changes in the immune response, the effects of exposure to this pollutant on the resistance of squirrel monkeys to influenza were studied. The exposure of test animals infected with mouse-adapted influenca virus to 10 ppm of NO2 resulted in the development of an acute disease culminating in the death of 9 out of 10 animals within 4 days after the infectious challenge and initiation of the NO2 exposures. Exposure to 5 ppm NO2 did not produce excess mortalities, and exposure to 1 ppm did not result in any mortalities among monkeys challenged with the monkey-adapted strain of influenza virus. In monkeys exposed to 1 ppm NO2 for 16 months and challenged with the virus, histopathological examination revealed moderate to slight emphysema with thickened bronchial and bronchiolar epithelium; these changes were not seen in animals exposed only to NO2 or the virus. With the mouse-adapted strain of influenza virus, the ability to form serum neutralization antibodies appeared to be depressed in monkeys exposed to 5 ppm NO2. Conversely, upon challenge with the monkey adapted influenza virus, the serum neutralizing antibodies appeared sooner and at significantly higher levels in monkeys exposed to 1 ppm NO2. (Author summary modified)

**34015** **APTIC NO. 56607**

Einbrodt, Hans-Joachim, Jindrich Rosmanith, Georg Delbeck and Heiner Amort

THE BIOLOGICAL EFFECT OF ZINC WITH REGARD TO EMISSION LIMITATION FOR MAN. *(Die biologische Wirkung von Zink im Hinblick auf eine Immissionsbegrenzung fuer den Menschen). Text in German. Staub, Reinhaltung Luft, 33(11):453-457, Nov. 1973. 78 refs. (Presented at the VDI Colloquium on Heavy Metals as Air Pollutants, Duesseldorf, Feb. 22-23, 1973.)*

From a review of the literature, the maximum allowable zinc concentration has been calculated as 0.1 mg/cu m as a 24-hour average. Measurements of the zinc emission in Essen in winter 1970/71 produced an average monthly concentration of 0.2 micrograms/cu m. In the distance of 1 km from a zinc plant, the monthly averages for the months November 1970 to December 1971 were between 0.5 and 1.7 micrograms/cu m. Apart from acute occupational zinc poisoning, chronic zinc injuries could not be clearly confirmed. Examinations of workers exposed to zinc oxide and other zinc compounds for periods from 2 to 35 years yielded no physical damages which could be specifically attributed to zinc. However cases of chronic pneumoconioses after long years of zinc stereate exposure shed some doubt on the harmlessness of chronic exposure to zinc dust. Malignant tumors could be produced in 15% of the rats and rabbits within 18 to 24 months after intratracheal, subcutaneous, and intratesticular injection of highly disperse metallic pulverized zinc and zinc chloride in solution. Most of the tumors formed in the esophagus and the pleural cavity. Up to 2500 ppm zinc fed to rats in form of zinc chloride or zinc carbonate produced no toxic symptoms. The lethal dose of orally ingested ZnC12 for 50% of the rats was 350 mg/kg, for mice 350 mg/kg, and for guinea pigs 200 mg/kg.

**34016** **APTIC NO. 56567**

Fletcher, C. M.

CAUSES AND DEVELOPMENT OF CHRONIC AIRWAYS OBSTRUCTION AND ITS FURTHER INVESTIGATION. *Bull. Physio-Pathiol. Respir. (Nancy), 9(4):1134-1148, July/Aug. 1973. 99 refs.*

Destructive emphysema and obstructive bronchitis are the main causes of persistent airway obstruction. The pathogeneses of these two conditions are difficult to separate because they usually coexist. Epidemiological studies have emphasized the predominant role of cigarette smoking and air pollution in their causation. Occupational exposure to dust and irritating gases contributes in some cases. The roles of socioeconomic factors and climate are uncertain, whereas constitutional factors must be important. A recent study of the natural history of the bronchitis-emphysema syndrome showed that cigarette smoking encourages mucous hypersecretion, infection, and airways obstruction independently, but that neither mucous excess nor bronchial infection leads to airways obstruction. Forced expiratory volume and vital capacity provided a useful prognostic index and the cessation of smoking arrested the pathological progression. Factors which determined individual susceptibility to the harmful effects of cigarette smoke and other pollutants need to be identified. Lack of the inhibition of proteolytic enzymes may be one cause of emphysema, whose different forms presumably have different causes. Since cigarette smoke is the main etiological agent, prevention at present depends on helping people to avoid or stop this habit or developing acceptable, less harmful forms of smoking. (Author abstract)

**34017** **APTIC NO. 56583**

Fondimare, A., J. Tayot, J. Desbordes, J.-L. Ernoult, and J. Perrotey

SYSTEMATIC STUDY OF PULMONARY ASBESTOS DEPOSITS IN THE LE HAVRE REGION. *(Etude systematique de l empoussierage pulmonaire par l amiante dans la region Havraise). Text in French. Arch. Anat. Pathol., 21(3):273-278, Sept. 1973. 11 refs.*

Asbestos or ferruginous bodies in expectoration from 264 patients and in pulmonary parenchyma samples obtained from another 50 patients by autopsy or operation were studied. The organic matter of the samples was dissolved, and the solute was concentrated on Millipore membrane for microscopic and electron microscopic studies. While 20% of all expectoration samples were found positive, the corresponding figure for tissue samples was 94%. Isolated asbestos bodies, or such associated with ferruginous bodies, were detected in the positive phlegm samples. Fibers of chrysotile and amosite were tentatively identified by the electron diffraction method The study revealed the quasi-ubiquitous occurrence of asbestos bodies in the population of the Le Havre region. The number of asbestos bodies found in tissue samples seems to be 10 to 100 times higher than that in expectoration samples. The ratio of the numbers of asbestos bodies revealed by optic microscopy and electron microscopy is 1:1000 to 1:1,000,000. The experiences demonstrate that the presence of a few asbestos bodies in the expectoration, and of less than 100 asbestos bodies in the pulmonary parenchyma are due to occasional dust exposure without pathologic consequences. The presence of more than 100 asbestos bodies in the expectorate, and of over 1000 in tissue samples represent elevated professional hazards, and coincide most frequently with pulmonary fibrosis. Almost all patients in this group had bronchopulmonary tumors, and two cases of primitive pleural tumor and mesothelioma were also observed.

**34018** **APTIC NO. 56734**

Foote, Christopher S.

PHOTOSENSITIZED OXIDATION AND SINGLET OXYGEN: CONSEQUENCES IN BIOLOGICAL SYSTEMS. *Preprint, California Univ., Los Angeles, Dept. of Chemistry, 51p., 1973. 300 refs.*

A survey is presented of the known and probable chemical and biological consequences of photosensitized oxidations involving singlet oxygen. Topics covered include: photooxidation mechanisms and rates of processes; the photodynamic effect in both biological and chemical systems; medical implications of the photodynamic effect involving porphyria, treatment of neonatal jaundice, and photocarcinogenesis; and the action of singlet oxygen in bioligical enzyme systems. Photodynamic damage has been observed in virtually all classes of organisms and the effects include membrane damage, mutagenesis, and interference with metabolism, reproduction, and many other life processes. Microorganisms, multicellular plants, animals, and humans are all affected. Drug photosensitivity reactions in humans may belong to this class, and certain porphyrias result in the deposition of sensitizing blood porphyrins in the skin. The effect of tocopherol in protecting against hemolysis may be associated with its ability to react with singlet oxygen or with its activity as a free radical inhibitor or both. The association between photosensitizing ability and the carcinogenicity of polynuclear aromatic hydrocarbons has been made repeatedly, and many photodynamic photosensitizers are capable of producing tumors on prolonged irradiation.

**34019** **APTIC NO. 56484**

Hilfrich, J., H. Bresch, J. Misfeld, and U. Mohr

INVESTIGATION ON THE CARCINOGENIC BURDEN BY AIR POLLUTION ON MAN. V. TUMORS OF THE RESPIRATORY TRACE IN SYRIAN GOLDEN HAMSTERS AFTER INTRATRACHEAL INSTILLATION OF BENZO(A)PYRENE. *Zentralbl. Bakteriol., Parasitenk. Infektionskr. Hyg.: Abt. 1:Orig., Reihe B, 158(1):59-61, 1973. 3 refs.*

Three-month old female Syrian hamsters, 180 in number, were intratracheally treated with doses of benzo(a)pyrene which were geometrically increased from 0.1 to 9.77 mg (factor 2.5). As a dispersing agent, 0.9% saline was mixed with a solution consisting of 1% sodiumdodecylsulfate (SDS) in 0.01 m Tris-HCl (pH equals 7.4) and 0.001 m ethylenediaminetetraacetic acid sodium salt (EDTA); 0.02 ml of this solution was added to 6 ml saline. The benzo(a)pyrene for each dosage was suspended in 0.2 ml of this dispersing agent. One control group of 30 female hamsters, also 3 months old, was weekly treated with 0.2 ml of the dispersing agent. The hamsters were kept under standard laboratory conditons of 22 C and 55% relative humidity and received food and water ad libitum and were observed until they spontaneously died. All animals were autopsied and the respiratory tract was fixed in 10% buffered formalin. With increasing doses, the survival rate decreased. In

**addition to the hyperplastic, dysplastic, and metaplastic alterations of the tracheal and bronchial epithelium produced after more than 30 weeks or about 18 weeks with 0.25 and 0.63 mg benzo(a)pyrene, 30% of all animals in each of these two groups developed neoplasms of the lungs (bronchogenic and squamous cell carcinomas).**

**34020** **APTIC NO. 56836**

Howlett, Lyle and Roy J. Shephard

CARBON MONOXIDE AS A HAZARD IN AVIATION. *J. Occupational Med. (Ottawa), 15(11):874-877, 1973. 60 refs.*

**The susceptibility of aviation personnel to carbon monoxide poisoning is compared with that of the general population. Taxi drivers and baggage handlers may encounter very high CO2 concentrations. Aircrews are exposed to comparatively lower concentrations, but because of synergistic stresses and severe task demands, are at greater risk. Exposure should not exceed 40 ppm for 1 hour, or 15 ppm for 8 hours. While there are special hazards associated with military and northern flying, the primary dangers leading to excessive exposure in commercial operations are: the journey to the airport; contamination of departure lounges by cigarette smoke and vehicle exhaust; and high runway CO2 concentrations when take-off is delayed. Improvements in vehicle design may reduce the problems associated with the initial road journey. In addition, smoking should be prohibited in departure lounges and the air intake should be at a sufficiently high level to avoid local contamination by vehicle exhaust. Runway exposures might be reduced by the increased use of electrically operated tractors. (Author summary modified)**

**34021** **APTIC NO. 56841**

Kyei-Aboagye, K., M. Hazucha, I. Wyszogrodski, D. Rubinstein, and M. E. Avery

THE EFFECT OF OZONE EXPOSURE IN VIVO ON THE APPEARANCE OF LUNG TISSUE LIPIDS IN THE ENDOBRONCHIAL LAVAGE OF RABBITS. *Biochem. Biophys. Res. Commun., 54(3):907-913, Oct. 1, 1973. 17 refs.*

**Twenty hours after the injection of a mixture of (3H)oleate and (14C)palmitate, the lungs of rabbits exposed to 1 ppm ozone for 4 hours showed a decreased incorporation of fatty acids (particularly (3H)oleate) into lecithin. In addition, the endobronchial lavage from these animals showed increased specific activity of both (3H)oleyl lecithins and (14C)palmitoyl lecithins. These observations indicate that ozone may affect the lung by decreasing the formation of lecithins while simultaneously stimulating the release of surfactant lecithins. (Author summary)**

**34022** **APTIC NO. 56597**

Mandschgaladse, R. N. and W. I. Waschakidse

SOME GENETIC ASPECTS OF THE ACTION OF INDUSTRIAL AND AGRICULTURAL POISONS ON THE ORGANISM. *(Einige genetische Aspekte der Wirkung der industriellen und landwirtschaftlichen Gifte auf den Organismus). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A19-A20.*

**The gonadotropic, embryotropic, and mutagenic effects of sub-threshold doses of manganese chloride, potassium permanganate, ethylmercury chloride, N-naphthylmethylcarbamate, and trichloromethylthiotetrahydrophthalimide were studied in rats and mice. Statistically significant decreases in the motility of spermatozoa, inhibition of the redox processes, reduction of the weight coefficient of the testicles, and significant prolongation of the estrocycle were observed. Increased number of non developed embryos, reduced rate of implantation, increased embryonal and post-embryonal mortality, reduced rate of development, and retardation of the maturation of the genitalia were observed in the test animals and their offspring, respectively. Trichloromethylthiotetrahydrophthalimide and N-naphthylmethylcarbamate had teratogenic effect. Increased susceptibility to the preparations by rats during organogenesis, and increased susceptibility of mice during the first half or the entire period of the embryogenesis were determined.**

**34023** **APTIC NO. 56936**

Miyoshi, H.

AN EPIDEMIOLOGICAL STUDY ON THE PHOTOCHEMICAL SMOG-LIKE INCIDENTS IN AN INDUSTRIAL CITY, TOKUYAMA, YAMAGUCHI PREFECTURE. *(Tokuyama-shi ni okeru kokagaku sumoggu-yo jirei no ekigakuteki kenkyu). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):412, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973.)*

**Two air pollution episodes involving photochemical smog-like conditions are described, and the biological effects are discussed. The first incident occurred in a narrow mountainside area near a group of factories along a road carrying a few thousand vehicles per day. There was a northwest to south-southwest breeze of 0.3-1.4 m/sec. Aerial concentrations of nitric oxide, nitrogen dioxide, and oxidants were 0.028-0.063, 0.024-0.104, and 0.007-0.044 ppm respectively. During the incident 266 patients were reported, mostly schoolchildren. The second incident occurred in the center of a city next to a group of factories along a road carrying 20,000-30,000 vehicles per day. The northwest to south-southwest breeze moved at 0.8-2.4 m/sec. Aerial concentration of nitric oxide, nitrogen dioxide, and oxidants were 0.010-0.040, 0.030-0.110, and 0.015-0.113 ppm, respectively. Eighteen patients were reported. The origin of photochemical smog-like incidents are pollutants which would normally be exhausted from high stacks or a temporarily exhausted special gas. Auto exhaust is not included in this category.**

**34024** **APTIC NO. 56833**

Montgomery, Mark R. and Robert J. Rubin

OXYGENATION DURING INHIBITION OF DRUG METABOLISM BY CARBON MONOXIDE OR HYPOXIC HYPOXIA. *J. Appl. Phys., 35(4):505-509, Oct. 1973. 22 refs.*

**Carbon monoxide inhalation inhibits hepatic drug metabolism and prolongs drug responses in rats. Experiments were undertaken to determine whether CO acts directly on the CO-sensitive component of the drug-metabolizing enzyme system, or indirectly by binding to hemoglobin and causing hypoxia. Greater decreases in both arterial oxygen content and hepatic venous oxygen tension were required during CO exposure than during hypoxic hypoxia to produce a given pharmacologic response. Since a direct mechanism of action by CO would require it to be more effective than hypoxic hypoxia, this observation rules out such a possibility. The greater potency of hypoxic hypoxia may be related to its reflex effects on liver-blood flow mediated by the decreased arterial Po2 rather than to its effect on liver cell oxygenation. In vivo rates of drug metabolism are blood flow-dependent rather than O2-dependent over a wide range of oxygenation. (Author abstract)**

**34025** **APTIC NO. 56635**

Nechay, Maria W. and F. William Sunderman, Jr.

MEASUREMENTS OF NICKEL IN HAIR BY ATOMIC ABSORPTION SPECTROMETRY. *Ann. Clin. Lab. Sci., 3(1):30-35, 1973. 32 refs.*

**Measurements of nickel concentrations were performed by atomic absorption spectrometry upon samples of hair obtained from 20 healthy subjects (ages 21-80 years) in order to establish body burdens and indices of environmental and occupational exposures. Samples were restricted to segments of hair fibers which did not exceed 5 cm distance from the scalp. The concentrations of ni in the 20 hair samples averaged 0.22 plus or minus 0.08 micrograms/g, with a range of 0.13-0.51. No**

significant difference was observed between mean Ni concentrations in hair from men or women, nor was any correlation noted bwtween Ni concentrations and the color of the hair samples. There was a slight but significant diminution in Ni concentrations with advancing age. Increased concentrations were observed in hair samples from subjects whose sub-occipital hair exceeded 10 cm in length and in subjects whose hair had been dyed or treated with permanent wave solutions. Such measurements may be used to supplement Ni analyses of serum and urine as indices of the Ni body burden. (Author abstract modified)

**34026** **APTIC NO. 56835**

Nieding, G. Von, H. M. Wagner, and H. Krekeler

INVESTIGATION OF THE ACUTE EFFECTS OF NITROGEN MONOXIDE ON LUNG FUNCTION IN MAN. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A14-A16. 6 refs.*

The acute effects of nitrogen monoxide on lung function in man was examined in terms of respiratory gas exchange, the mechanics of breathing, and the formation of Methemoglobin. One hundred and ninety-one healthy subjects between the ages of 20 and 50 years were exposed to NO/air mixtures for 15 minutes. The results indicated that NO has a detrimental effect on human lung function at low concentrations, although significant changes in lung function are not evident with NO concentrations below 15 ppm. Although both NO and nitrogen dioxide may act on the human lung by a similar mechanism, NO appears to be markedly less toxic with regard to lung function than NO2. An MAC value based on these results which takes into consideration the relation of the individual toxicities seems to be reasonable.

**34027** **APTIC NO. 56935**

Nose, Y., S. Ueno, M. Nakayama, and A. Takamatsu

COMPARISON OF BIOLOGICAL EFFECT BETWEEN PHOTOCHEMICAL SMOG AND NON-PHOTOCHEMICAL SMOG. *(Kokagaku sumoggu to hi-kokagaku sumoggu no seitai eikyo hikaku). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):413, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973.)*

An accident in a chemical factory in Ube created an air pollution episode in which the aerial concentration of sulfur dioxide and nitrogen dioxide showed abnormally high values for 70 days. Inhabitants of the industrial area complained of eye irritation and problems of the nose and pharyngo-respiratory system, and there was an increased mortality of heart and lung patients. Considerable plant damage also occurred. Biological effects from photochemical and non-photochemical smog were compared.

**34028** **APTIC NO. 56906**

Pontus, Micheline and Michel Delmelle

REDUCTION OF NITROXIDE RADICALS BY PHOTORECEPTOR CELL MEMBRANES. *(Reduction de radicaux nitroxides par des membranes de cellules photoreceptrices). Text in French. C. R. Acad. Sci. Paris Ser. D., no. 277:1069-1072, Sept. 1973. 8 refs.*

The reduction of nitroxide radicals by the photoreceptor cell membranes of the bull retina isolated according to the Abrahamson technique was studied by electron paramagnetic resonance, using 2,2,6,6-tetramethyl-piperidine-1-oxyl (Tempo) for spin-labeling. The observed reduction of the nitroxide radicals by the photoreceptor cell membranes is due to the thiol groups of rhodopsine, and to the oxidation of the double bonds of the non-saturated fatty acids of the membranes.

**34029** **APTIC NO. 56423**

Robison, W. L., L. R. Anspaugh, W. H. Martin, and O. A. Lowe

COMPILATION OF PUBLISHED INFORMATION ON ELEMENTAL CONCENTRATIONS IN HUMAN ORGANS IN BOTH NORMAL AND DISEASED STATES. 4. DATA SUMMARY ORDERED BY SPECIFIC HEALTH STATE, SUBORDERED BY ATOMIC NUMBER, ORGAN, AND SUBORGAN. *Lawrence Livermore Lab., Livermore, Calif., Bio-Medical Div., Atomic Energy Commission Contract W-7405-Eng-48, 214p., 1973. 4 refs.*

NTIS: UCRL-51013 Pt. 4

A data summary of elemental concentrations ordered by disease state and subordered by organ, suborgan, and atomic number is presented. This report is a compilation of the published data on the elemental content of human tissues in both healthy persons and those afflicted with one or more diseases. The inclusion of data regarding all disease states provides additional opportunities of studying systematically the possible etiological or secondary roles that the metabolism of elements may have in the manifestation of these disease processes. The geographical source of the samples analyzed is also included. These data can be helpful in relating elemental content to geographical location and also in correlating the role of elemental metabolism in certain disease processes, since some diseases are more common to specific areas than others. The project is primarily computer oriented. The information coded, other than the element and its concentration, includes literature reference, method of analysis, geographical source, age, sex, organ, suborgan, health state, concentration unit, and number of individuals analyzed. The data from many papers can be extracted as a function of any of these variables.

**34030** **APTIC NO. 56598**

Roussel, A., G. Bouley, R. Roudier, A. Dubreuil, J. Godin, and C. Boudene

PROLONGED ACTION OF SMALL ACROLEIN CONCENTRATIONS ON THE RAT. *(Action prolongee de faibles doses d acroleine sur le rat). Text in French. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A17-A18. 8 refs.*

The effect of inhaled acrolein on the organism of Sprague-Dawley rats was studied. The rats were exposed to acrolein concentrations of 0.53 to 0.63 cu cm/cu m for 2 to 6 months. Compared to a control group, the test group showed significant decreases in body weight, in the weight of the lungs, as well as in the food and water intake by the animals. Alveolar modifications with hypertrophy, and homogenization of the hepatic structures in some of the test animals were observed. No other organs were affected by the chronic exposure to acrolein.

**34031** **APTIC NO. 56617**

Rylander, Ragnar and Rikard Bergstroem

PARTICLES AND SO2 - SYNERGISTIC EFFECTS FOR PULMONARY DAMAGE. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A23-A25. 10 refs.*

Controlled infection and conventional guinea pigs were exposed for four weeks to sulfur dioxide, manganese dioxide dust, and carbon monoxide, alone and in combination, and were subsequently sacrificed for histological examination of the trachea and lungs in order to determine whether a synergistic effect could be demonstrated by the combination of SO2 and particulates and by the addition of CO. The number of macrophages and leukocytes was lower in the infection controlled animals than in conventional animals, and the standard deviation was also lower. Exposure to SO2 did not affect the number of macrophages or leukocytes in either group. Exposure to MnO2 caused a slight increase in the number of macrophages in the infection controlled group, and the number of leukocytes was increased in both groups. Simultaneous administration of MnO2 and SO2 resulted in increased numbers of macrophages to about the same level as when MnO2 was given. The number of leukocytes increased considerably. The proportional increase was somewhat higher in the infection controlled animals, but the absolute level reached was about twice as high in the conventional animals. Addition of CO to the mixture of MnO2 and SO2 did not affect the number of macrophages, although the number of leukocytes was lower (still higher than in the controls). Sole administration of CO resulted in a decrease in the number of leukocytes as compared to the controls. Sulfur dioxide exposure did not markedly affect the distribution of irritation, whereas MnO2 caused a slight increase, and a combination of the two caused an appreciable increase which was more easily seen in infection controlled animals. Addition of CO did not affect the score. The correlation coefficient between irritation score and macrophages for the combined exposure group was 0.23 and that for correlation between irritation score and leukocytes was 0.58.

**34032** **APTIC NO. 56934**

Sato, Y., H. Tsunoda, and N. Konno

EXPERIMENTAL EXPOSURE OF GOATS TO ENVIRONMENTAL POLLUTION BY FLUORIDES IN THE AIR, PART III: ON THE TRANSPLACENTAL PASSAGE OF FLUORIDES. *(Taikichu fukkabutsu no kankyo osen ni yoru yagi no bakuro hikken -dau 3po- fukkabutsu no taiban tsuka ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):420, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973.)*

The fluorine content of the blood of a mother goat bred in fluoride-polluted air was determined and compared to the F2 levels in the hard and soft tissues of her kids directly after birth. The F2 levels in the serum of one mother goat fluctuated widely between 0.05-0.6 ppm in a year, but the other experimental goat had a more stable level of 0.05-0.15 ppm. The average F2 content was higher before, rather than during, pregnancy. The distribution of F2 in the kids concentrated in the aorta and the spleen from the soft tissues, and in the ribs, vertebrae, and bones (excluding teeth), from the hard tissues. A correlation between the F2 contents of the mother's serum and the F2 contents in the kid's body, especially in the hard tissues, was recognized.

**34033** **APTIC NO. 56831**

Satomi, H. and K. Takahashi

CLINICAL ANALYSIS OF DAMAGES DUE TO PHOTOCHEMICAL SMOG. *(Kokagaku sumoggu higai no rinsho kaiseki). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 20(10), 1p., 1973. (Presented at the Japan Society of Public Health, Annual Meeting, 32nd, Oct. 1973, Paper 555.)*

Children during a photochemical smog episode in Tokyo on May 12, 1972 had symptoms of eye irritation, nasal congestion and ache, sneezing, throat irritation, coughing, sputum, stridor, numbness of extremities, aches, convulsions, nausea, diarrhea, headache, dizziness, fatigue, feverishness, and unconsciousness in 22 cases. The school has had several smog episodes since then. Respiratory symptoms and convulsions increased over the general school term. Exercise increased the severity of the symptoms. Some children complained of the symptoms for several months. The symptoms of hospitalized students are described. The effects of the smog on post office workers and housewives living the nearby areas are mentioned. The causes of photochemical smog episodes in the area such as weather and topographic location are described.

**34034** **APTIC NO. 56599**

Schlipkoeter, Hans-Werner, George G. Fodor, Luijina Ghelerter, and Reinhard Dolgner

FINDINGS FROM ANIMAL TESTS CONCERNING SYNERGISM. *(Tierexperimentelle Befunde zur Kombinationswirkung). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West German 1973, p. A26-A30. 4 refs.*

Synergism of 5-6 ppm of sulfur dioxide, 1.5 ppm of hydrochloric acid, 3 ppm of nitrogen dioxide, 0.5 ppm of nitric oxide, 50 and 100 ppm of carbon monoxide, 0.86 ppm of ozone, 50-1000 ppm of dichloromethane, and 7 mg/cu m concentration of soot-dust in their different combinations on physiological parameters were studied in NMRI and C 57 BL line mice and in Wistar rats. Combinations of SO2 with HCl caused increase in erythrocytopoiesis. Combinations of SO2 with NO2, especially together with dust, intensified this change even more. Ozone and CO had antagonistic effects on the erythrograms. Dust and SO2 alone, as well as SO2 with NO2 or HCl caused no thrombopenia, while combinations of SO2 or NO2 with dust did. No increase in the parinfluenza I mortality due to SO2 alone or in combination with HCl was observed. Stimulation of the primary and secondary antibody formation by 5 ppm SO2 for 80 days is assumed. Exposure for 4 months to SO2, or NO2 with HCl retarded the elimination of bacteria following micrococcus aerosol inhalation. The effect of Plasmodium berghei on erythrocytes was not changed by SO2 or soot alone, or by SO2 with soot, or by SO2 with NO2 and HCl. Inhalation of SO2 together with NO2 for 18 months sensitized the erythrocytes. Combinations of SO2 with CO, and of CO with NO or SO2 with NO2 failed to intensify the reduction of the lead induced decrease in the aminolevulinic acid dehydratase activity. Combinations of SO2, NO2 and dust delayed, however, the normalization of the previously reduced aminolevulinic and dehydratase activity. Endogeous formation of CO following halogenated hydrocarbons, such as dichloromethane, was observed.

**34035** **APTIC NO. 56603**

Schlipkoeter, Hans-Werner, Pavel Schmidt, and Ladislav Pelech

THE HEALTH STATUS OF SCHOOLCHILDREN IN AREAS WITH POLLUTED AIR. *(Der Gesundheitszustand von Schulkindern in luftverunreinigten Gebieten). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A59-A62. 5 refs.*

A comparative study of some biological parameters in schoolchildren living in a highly industrialized urban area (Gelsebkirchen) and in rural areas (Westerland, Thalfang, Hunsrueck, and the Freiburg-Breisgau area) with rather low pollution levels is described. The yearly averages of the dust and sulfur dioxide concentrations were 287 micrograms/cu m and 181 micrograms/cu m in Gelsenkirchen; 4 and 11 times lower concentrations in Westerland, as well as 4 and 6 times lower values in the Freiburg/Breisgau area. Increased frequency of the enlargement of the tonsils, neck and submandibular lymph nodes, slightly lower body weight, retarded ossification (as an indicator of biological age), reduced erythrocyte count, reduced hemoglobin level, and reduced acid resistance of the erythrocytes in the exposed group were observed. All changes were within the normal range of variations. Body height and hemoglobin level were found to be irrelevant as biological indicators of air pollution in the relation of the children living in Gelsenkirchen as compared with those living in the less-polluted Freiburg- Breisgau area. However, the negative deviation of the age of the hand bones from the actual age, and the erythrocyte concentrations, *were higher, but the reduced* erythrocyte hemoglobin content was lower in the exposed group. The resistence of the erythrocytes to hydrochloric acid was also lower in exposed children.

**34036** **APTIC NO. 56592**

Shalamberidze, O. P.

DATA ON EFFECT OF SOME ATMOSPHERIC CONTAMINANTS ON THE GENERATIVE FUNCTION OF ANIMALS. *Proc. Int. Clean Air Congr., 3rd., Duesseldorf, West Germany, 1973, p. A21-A22. 7 refs.*

Vaginal smears and pathomorphological studies were assessed for female albino rats exposed to inhalation of various concentrations and mixtures of nitrogen dioxide, sulfur dioxide, and carbon monoxide in an effort to determine the effects of such air contaminants on the generative function of animals. Microconcentrations of sulfur dioxide and nitrogen dioxide, 0.159 and 0.126 mg/cu m respectively, did not cause change in the normal course of oestral cycle; while chronic influence of carbon monoxide concentrations of 1.0 and 2.0 mg/cu m as well as sulfur dioxide and nitrogen dioxide in higher concentrations, applied separately and in mixture, did give rise to such disturbances characterized by prolongation of the oestral cycle at the expense of the interestrum, by an increase of the estral period, and a decreasing total number of cycles per month. The most marked deviations were observed after the second and third month of exposure. Exposure of the rats to $SO_2$ and $NO_2$, as well as their mixture, appeared to impair the intrauterine development of the foetus, and an approximately analogous picture was observed for long-term exposure to CO. Study of the estral cycle in the posterity of exposed rats revealed changes in the cycle when CO at concentrations mentioned above or $SO_2$ and $NO_2$ at higher concentrations were inhaled. These changes in the estral cycle were accompanied by pathohistological alterations in several organs.

**34037** **APTIC NO. 56479**

Symon, Karel and Vladimir Bencko

HEALTH ASPECTS OF AIR POLLUTION BY ARSENIC. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A53-A55. 5 refs.*

Epidemiological studies involving audiometric measurements and the determination of arsenic concentrations in the hair and urine of exposed children were performed to assess the effect of inhalation of the substance resulting from the burning of high arsenic coal by power plants in the area. The relationship between the arsenic content of the hair and the distance from the source of contamination was not a simple one and corresponded to the theoretical expectations of the spread of emissions from stacks as formulated in the equations of Sutton. Statistical analysis of the difference between the exposed and control groups demonstrated significance levels of 0.1% and 1.5% for the four communities closest to the source and the more distant ones, respectively. Investigation of the arsenic content in urine was not conclusive. Audiometric examinations demonstrated hearing losses in exposed children, and these losses predominated in the lower and high frequency ranges. Increased auditory threshold at low frequencies was probably caused by a higher incidence of catarrhs of the nasopharynx and the middle ear in the exposed community, possibly a consequence of the polluted atmosphere; auditory loss in the high frequency range cannot be similarly explained. Suspected central damage was not excluded.

**34038** **APTIC NO. 56933**

Takizawa, Y.

ON THE INFLUENCES OF FLUORIDES ON HUMAN BODY. *(Fukkabutsu no jintai ni oyobosu eikyo ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):421, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973.)*

An epidemiological investigation was conducted on the total population residing within 1 km of an aluminum refinery. Fluorine content in the urine, subjective symptoms, percussion, stethoscopy, dental health, respiratory function, hematology, alkaline phosphatase, basal metabolism, ECG, chest and bone x-rays, and urinalysis were considered. The investigations on persons older than 40 and children between 3 and 15 show the following: fluoride ion concentration was higher in the polluted area for both age groups, macular teeth appeared 2 times as frequently in the polluted area, the frequency of caries in permanent teeth was 69% in the polluted areas, anomalies of bone development in children were more frequent in the polluted areas, respiratory complaints were more frequent in the polluted areas and chronic bronchitis morbidity was high, diffuse shadows on the lungs were found in the polluted areas, and deposition of Al was less than 10 micron in all respiratory systems.

**34039** **APTIC NO. 56930**

Tomita, K., S. Yamaoka, I. Kawaraya, K. Haruki, and H. Murayama

LEAD CONTENT IN THE BLOOD AND URINE OF TRAFFIC POLICEMEN. *(Kotsu keisatsukan no kecchu, nyochu enryo ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 8(3):415, Oct. 1973. (Presented at the Japan Society of Air Pollution, Annual Meeting, 14th, Fukishima, Japan, Nov. 6-8, 1973.)*

Lead content in the blood and urine of traffic policemen was measured by atomic absorption spectrophotometry. A correlation equation was obtained in which Pb in the blood equals 0.417 times the Pb in urine plus 7.56. When the Pb in the blood was larger than 15 micrograms/dl, the Pb in the urine was larger than in the blood. In descending order, blood Pb levels were highest in traffic policemen in the city, patrolmen in the city, inhabitants along the main street, policemen who work inside buildings in the city, policemen who work in buildings outside the city, female traffic patrols in the city, and patrols outside the city.

**34040** **APTIC NO. 56931**

Tsunoda, H.

EXPERIMENTAL EXPOSURE OF GOATS TO ENVIRONMENTAL POLLUTION BY FLUORIDES IN THE AIR. PART I. OUTLINE OF THE EXPERIMENT. *(Taiki chu fukkabutsu no kankyo osen ni yoru yagi no bakuro jikken -dai 1op- jikken gaiyo). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 8(3):418, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, Fukushima, Japan, 14th, Nov. 6-8, 1973.)*

Goats are bred in fluoride-polluted fields to determine the effects of air and environmental pollution. Experimental goats were bred in fields 0.1 km and 0.5 km away from an aluminum refinery. The average concentrations of hydrogen fluoride in the air were 0.9-2.6 ppm and 0.5-0.6 ppb. The goats are fed 21.8-42.6 ppm $F_2$ in dried herbs and 3-7 ppm $F_2$ in bran and potatoes. Control goats are pastured 4-6 km from the factory in a non-polluted area and fed 5-9.9 ppm $F_2$. Monthly analysis shows $F_2$ contents in the blood 4-6 times greater in the experimental goats, and 5-7 times greater in the urine. The $F_2$ in the feed is more influential than the $F_2$ in the air.

**34041** **APTIC NO. 56873**

Van Gelder, Gary A., Thomas L. Carson, Richard M. Smith, William B. Buck, and George A. Karas

NEUROPHYSIOLOGIC AND BEHAVIORAL TOXICOLOGIC TESTING TO DETECT SUBCLINICAL NEUROLOGIC ALTERATIONS INDUCED BY ENVIRONMENTAL TOXICANTS. *J. Am. Vet. Med. Assoc., 163(9):1033-1035, Nov. 1973. 13 refs.*

The development of adequate methods for the assessment of the dynamic functioning of the nervous system in the intact organism is one of the major challenges of medical research. Nerve condition tests and quantitative electromyography have been used in clinical and public health situations. Behavioral toxicology is a relatively new specialty that combines the resources of the experimental psychologist and the toxicologist in determining the deleterious effects of drugs and chemicals on behaviors such as learning or memory. Examples are given of the effects of lead and organophosphorus insecticides on peripheral nerve functioning. Experiments are also reviewed that demonstrate the effect of low-level prenatal exposure to mercury and lead on postnatal behavior. The effect of low-level dieldrin exposure on learning behavior in squirrel monkeys is cited as another example of the recent contribution of behavioral toxicology toward a fuller understanding of the effects of common environmental neurotoxicants on brain functioning. (Author summary)

**34042** **APTIC NO. 56538**

Waldbott, G. L. and S. Steinegger

NEW OBSERVATIONS ON CHIZZOLA MACULAE *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A63-A67. 12 refs.*

Epidemiological findings are reviewed for four groups of individuals from widely separated geographical areas where outbreaks of skin lesions (maculae) occurred. Fluoride exposure either by industrial air pollution or by presence in the drinking water or vegetation was common to all outbreak areas. The skin lesions are round or oval maculae of one to two cm in diameter and not sharply delineated. They are painless upon digital pressure and remain unchanged upon diascopy. Color upon first appearance is pinkish-brown which turns to a darker red brown after five to seven days before gradual fading. There is no break of the skin, nor are the lesions raised above the surface. The limbs and to a lesser extent the trunk are the parts mainly affected. Histological specimens have shown mild pericapillary infiltrations with lymphocytes, neutrophiles, and mast cells involving the upper layer of the chorium. Laboratory studies showed eight of 22 cases exhibiting an elevation of alkaline phosphatase. Attempts to reproduce the lesions experimentally in mice and rats have failed thus far, and this fact combined with a higher incidence of lesions among children and women suggests that certain factors in addition to fluoride intake are involved.

**34043** **APTIC NO. 56937**

Watanabe, H., H. Murayama, S. Matsushita, K. Ono, T. Okuno, S. Nagakura, M. Araki, and Y. Taraoka

CARBON MONOXIDE IN EXPIRED AIR HEAVY METALS IN HAIR OF SCHOOLCHILDREN IN CITIES AND AROUND CITIES. *(Toshi oyobi shuben gakudo no koki CO oyobi tohatsuchu jukinzoku ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 8(3):416, Oct. 1973. (Presented at the Japan. Society for Air Pollution, Annual Meeting, 14th, Fukushima, Japan, Nov. 6-8, 1973.)*

Carbon monoxide and heavy metals in the hair of schoolchildren living in the industrial, commercial, residential, and rural areas of three cities were measured. The average CO in expired air in the winter was higher than in the summer and showed no correlation to the CO in the air, suggesting the effect of home heating. In warmer seasons a correlation between the average CO value and the CO value in outdoor air equals 0.825. The CO in expired air showed a correlation to home heating types, with coal burning being higher than petroleum, gas, and electricity. The highest CO-hemoglobin was 6.1-6.6% and the CO in the expired air was higher in the morning, suggesting the effect of coal burning the night before. The CO was higher in the expired air of schoolchildren living near the road, the maximum value being 18 ppm. Average measurements of the heavy metals in the hair were 0.0-0.3-0.4 microgram/g for cadmium, 12-22 micrograms/g for lead, 12.9-25.8 micrograms/g for copper, 144-213 micrograms/g for zinc, and 1.2-2.1 micrograms/g for manganese. All the measurements were higher in the urban areas. Lead showed a tendency to decrease yearly. Lead and Cu showed a high correlation between appearance in hair and floating dust.

**34044** **APTIC NO. 56829**

Watanabe, M., I. Tanaka, H. Shingu, J. Asaka, S. Kusumoto, T. Nakajima, and M. Sugiyama

THE CYTOTOXICITY OF OZONE. *(Ozon no saibo dokusei) Text in Japanese. Nippon Koshu Eisei Zasshi (Japan J. Public Health), 20(10), 1p., 1973. (Presented at the Japan Society of Public Health, Annual Meeting, 32nd, Oct. 1973, Paper 554.)*

Rabbit alveolar macrophages and human and rabbit tonsillar lymphocytes were exposed to ozone. The activity of the production of interferon was determined after exposure to 4 ppm ozone for 5 min and inoculation with a virus; suppression of production occurred. Alveolar macrophages were collected from a rabbit exposed to 5 ppm of ozone for 3 hr; production of interferon decreased conspicuously. The mobility of of alveolar macrophages from a rabbit exposed to 5 ppm of ozone for 3 hr showed strong suppression after exposure; the macrophages made coagulated blocks after exposure. Human lymphocytes exposed to O3 in vitro had conspicuous suppression in the production of interferon and synthesis of DNA; however, the latter recovered and accelerated after 24 hr. The disturbance of interferon production caused weakening of resistance to infection.

**34045** **APTIC NO. 56616**

Winneke, Gerhard, Elisabeth Groll-Knapp, and Joachim Kastka

EXPERIENCES WITH PSYCHOMOTOR AND SENSORY EFFECT CRITERIA WITHIN THE FRAMEWORK OF AIR HYGIENE RESEARCH. *(Erfahrungen mit psychomotorischen und sensorischen Wirkungskriterien im Rahmen der Lufthygieneforschung). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A31-A35. 25 refs.*

Comparative psychomotor and sensory tests, performed on humans exposed to 50, 100 and 150 ppm concentrations of carbon monoxide and of dichloromethane are described with respect to establishing psychomotor and sensory criteria of different air pollutants, and to methodological problems. Exposure to CO corresponding to a carboxyhemoglobin level of up to 10% did not cause any noteworthy changes in the results of the flicker fusion test and acoustic vigilance test, while a linear, statistically-secured dose-effect relationship between the CO concentration and the expectation potential was observed. Dichloromethane causes statistically significant, though fairly slight, deviations of the results of the acoustic vigilance test and the flicker fusion test from the control data. Psychomotor, sensory and vigilance performances were found to be much more affected by substances with narcotic and neurotoxic properties such as dichloromethane, than by substances with hypoxic action, such as CO. Substances with hypoxic action are assumed to affect primarily information processing, while narcotic-neurotoxic substances are believed to impair information perception functions.

## 1972

**34046** **APTIC NO. 56310**

Cralley, Lewis

EPIDEMIOLOGIC STUDIES OF OCCUPATIONAL DISEASES. *In: Industrial Environmental Health: The Worker and the Community. Lester V. Cralley (ed.), Academic Press, 1972, p. 1-69. 258 refs.*

A review of recent epidemiologic studies of the chemical stresses to workers is presented; only English language studies are included. Emphasis is placed on the environmental aspects and etiologic agents rather than on the biologic response. The substances reviewed include: aldrin, arsenic, asbestos, beryllium, cadmium, carbon disulfide, chlorine, chromite, coal, flax, hemp, jute, fibrous glass, fluoride, grains, hematite, magnetite, iron oxide, diisocyanates, lead, lindane, manganese, mercury and organomercury compounds, oil mist, organophosphorus pesticides, platinum, proteolytic enzymes, silica, particulates resulting from steel production, uranium, vinyl acetate, polyvinyl chloride, particulates resulting from welding operations, and wood.

**34047** **APTIC NO. 56335**

Finklea, J. F., D. I. Hammer, T. A. Hinners, and C. Pinkerton

HUMAN POLLUTANT BURDENS. *In: Determination of Air Quality. Gleb Mamantov and W. D. Shults (eds.), New York-London, Plenum Press, 1972, p. 49-56. 16 refs. (Presented at the American Chemical Society Symposium on Determination of Air Quality, Los Angeles, Calif., April 1-2, 1971.)*

Human pollutant burden patterns are examined in relation to serving as monitors of the environment, as indicators of biological response, as inputs into environmental standards development and appraisal, as channel markers for research, and as safeguards for recycling technology. A tissue, by definition, carries a pollutant burden whenever it contains an environmental residue greater than that needed for optimum growth and development; hence, human tissues are dose integrators for environmental pollutants. Pollutant burden appraisals have been applied to the metallic pollutants arsenic, cadmium, copper, lead, manganese, mercury, strontium, and zinc and have also been sketched for various persistent pesticides. Not all pollutants can be approached through pollutant burden studies, however. Such studies do not seem valid for oxidant air pollutants or sulfur dioxide; while carbon monoxide, nitrogen dioxide, and suspended particulate air pollution occupy an intermediate position.

**34048** **APTIC NO. 56493**

Goni, J., G. Remond, M. C. Jaurand, J. Bignon, G. Bonnaud, and G. Broulet

PRESENT POSSIBILITIES OF IDENTIFICATION OF (FERRUGINOUS BODIES) IN HUMAN LUNG USING THE SCANNING ELECTRON MICROSCOPE. *(Possibilities actuelles d identification des corps ferrugineux du poumon humain par la microsonde electronique et le microscope electronicque a balayage). Text in French. Rev. Tuberc. Pneumol. (Paris), 36(8):1223-1236, Dec. 1972. 27 refs.*

Twenty ferruginous bodies removed from the lungs of 20 subjects were studied using both the scanning electron microscope with an X-ray spectrometer and an electronic probe which permitted the demonstration of silicon in all cases, both in the filter and in the sheath. Magnesium, however, was not always detected (14 cases), and when found was often present in low concentrations; this may have been due to a loss of this element in the surrounding tissues. This situation considerably hinders chemical microanalytical methods for the identification of asbestos bodies. Calcium, zinc, copper, titanium, phosphorous, chloride, and barium were also noted in a few cases, either in the fiber or in the sheath. Epidemiological studies involving the use of crystallographic identification of the mineral involved are more important than microchemical studies. Various methodologies are discussed, and it is concluded that, in the future, overall automatic methods such as infrared rays or automatic polarizing microscopes will probably be used.

**34049** **APTIC NO. 56249**

House, Charles H.

POLLUTION ABATEMENT--MORE THAN MEETS THE EYE. *Anal. Instrum., vol. 10:1-8, 1972. 12 refs. (Presented at the Instrument Society of America, Analysis Instrumentation Division Symposium, Annual, 18th, 1972, Paper 72401.)*

A philosophical overview of air pollution is discussed. Health versus esthetic effects in terms of citizen concern and government action, emphysema death rate statistics versus the known air pollution areas, and filtering techniques and instrumentation as a function of particle size and probable lung burden are among the topics considered. The correlation has not been made between emissions and health effects, or between filtering techniques and health improvement. Instrumentation s role, traditionally that of quantifying a subjective data base, has not been employed to make this correlation, but rather simply to serve the needs within each scientific subcategory. A coordinated effort of all scientific disciplines is recommended rather than individual approaches. (Author abstract modified)

**34050** **APTIC NO. 56336**

Keil, Julian E., John F. Finklea, Samuel H. Sandifer, and W. Clinton Miller

PESTICIDE EXPOSURE INDEX (PEI). *In: Determination of Air Quality. Gleb Mamantov and W. D. Shults (eds.), New York-London, Plenum Press, 1972, p. 57-63. 7 refs. (Presented at the American Chemical Society Symposium on Determination of Air Quality, Los Angeles, Calif., April 1-2, 1971.)*

A 1-year study involving 78 occupationally-exposed and 63 control participants revealed that the Pesticide Exposure Index (PEI), calculated as the product of pesticide type, concentration, occupation of the exposed, and exposure time, it is a useful and effective tool. The PEI correlates significantly by (p less than .001) with the actual occurrence and levels in plasma of the pesticide pp DDT and its metabolites, pp DDE and pp DDD. The highest correlation coefficient was found for DDT (.43); while DDD was intermediate (.37), followed by DDE (.29). Calculation of coefficients of determination indicated that the lesser correlation of DDE was attributable to another source of variation; individual rates and types of hepatic and bacterial degradation may have varied. (Author summary modified)

**34051** **APTIC NO. 56314**

Kulle, Thomas J.

THE EFFECTS OF OZONE AND FORMALDEHYDE ON THE TRIGEMINAL NASAL SENSORY SYSTEM. *Cincinnati Univ., Div. of Graduate Studies, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1972. 124p., 30 refs.*

The effects of ozone and formaldehyde on the trigeminal nasal sensory system of the rat were studied. Both the ethmiodal and nasopalatine nerves responded to formaldehyde, ozone, and amyl alcohol. In all cases, the response was an exponential function of the stimulus concentration. A progressively increasing depression of the nasopalatine nerve response to the test odor (amyl alcohol) was produced with increasing (0.5, 1.0, 1.5, 2.0 ppm) concentrations of formaldehyde presented for a period of 1 hour. Perfusion of the nasal cavities with air for a period of 1 hour following the formaldehyde exposure resulted in a partial recovery of the neural response to odor. Exposure to 5 ppm ozone for 1 hour produced an increase in the nasopalatine nerve response to amyl alcohol. Perfusion of the nasal cavities with air for a period of 1 hour following the ozone exposure reduced the neural response to amyl alcohol, but did not bring it to preexposure levels.

**34052** **APTIC NO. 56806**

Lancranjan, Ioana, Mura Sukmansky, Lucia Stanuca, Claudia Antonescu, and H. I. Popescu

STUDY OF THE THYROID FUNCTION IN CHRONIC CARBON DISULPHIDE POISONING. *Med. Lavoro (Milan), 63(3-4):123-125, March/April 1972. 5 refs.*

Thyroid function was examined in 109 workers who were subject to chronic exposure to carbon disulfide and in 40 controls. Thyroid function was evaluated in terms the thyroid uptake of radioiodine, cholesterolemia, the thyroid plasmatic hormonal level (PBI and Halmolsky s test), and the results of endocrinological examinations. The data indicated that carbon disulfide did not induce alterations in thyroid function, and that the disorders of lipid metabolism observed in carbon disulfide poisoning are not produced by thyroid insufficiency. (Author summary modified)

**34053 APTIC NO. 56808**

Mostafa, M., A. Z. El-Sewefy, and Talat Abdel Hamid

CLINICAL BIOCHEMICAL AND ELECTROMYOGRAPHIC STUDY IN EGYPTIAN LEAD WORKERS. *Med. Lavoro (Milan), 63(3-4):109-116, March/April 1972. 16 refs.*

Electromyographic studies and conduction velocity studies of the radial nerve were performed on 20 workers known to have occupationally exposed to lead for a period of 1 to 36 years; all subjects exhibited various clinical symptoms, not necessarily related to Pb intoxication. The blood and urinary Pb levels were measured in all subjects. Eight cases showed EMG evidence of peripheral neuropathy; in seven of these cases, the neuropathy was latent, and in all the Pb levels, in the blood and urine were within acceptable limits. Lead was the only factor which could have accounted for the neuropathy in seven of these cases. The data indicate that the neuropathy was the result of a process of denervation and not a primary myopathic lesion. Electromyography and conduction velocity in the radial nerve are suggested as tools for the early discovery on Pb intoxication. (Author summary modified)

**34054 APTIC NO. 56497**

Nakai, Kazuo, Saburo Iizaka, Yoshitoshi Matsumoto, and Mutsumi Mitsuhashi

INVESTIGATION ON ENVIRONMENTAL CHARACTERISTICS OF TAISHIDO JUNIOR HIGH SCHOOL. *(Taishido chugakko ni okeru kankyo tokusei no chosa ni tsuite). Text in Japanese. Tokyo-to Eisei-Kyoku Gakkai-shi (Rept. Tokyo Public Health Studies), no. 50:106-107, Oct. 1972.*

Highly concentrated oxidants appeared more often at the Taishido Junior High School when the wind velocity was 1.0-3.9 m/sec than when it was less than 0.9 m/sec. Studies were affected more when the wind blew faster, and residents in the eastern neighborhood suffered more than the students. The highest oxidant concentration in the safe region was 0.04 ppm, maximum wind velocity was 8.0 m/sec. The largest number of patients appeared when the oxidant concentration was 0.06 ppm and the wind velocity was 3.0-3.9 m/sec. The cause of photochemical smog is discussed.

**34055 APTIC NO. 56903**

Rubino, G. F., G. Scansetti, and A. Donna

EPIDEMIOLOGY OF PLEURAL MESOTHELIOMA IN URBAN INDUSTRIAL AREAS. *(Epidemiologia del mesotelioma pleurico in aree industriali urbane). Text in Italian. Med. Lavoro (Milan), 63(7-8):299-315, July-Aug. 1972. 49 refs.*

Data on 102 cases of pleural mesothelioma admitted to the Institute of Medice of Turin University from 1960 to 1970 are examined. Occupational and residential history are reviewed. Histological, clinical, radiological, evolution, and punch biopsy techniques were used in the study. Among 50 cases of pleural mesothelioma, there was a positive history of exposure to asbestos in 10% of the cases; in 6% of the cases there was a history of living with asbestos workers; and in 6% the residence was near an asbestos factory. Asbestos bodies were found in only one of 18 cases. A 10% positive correlation of occupational exposure to asbestos with pleural mesothelioma was among the lowest found in similar studies in different countries. This can be explained by the moderate use of crocidolite in the region. A similar explanation can be given for the low incidence of asbestos bodies.

**34056 APTIC NO. 56453**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV(G): THE EFFECT ON HEALTH. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 150-172. 9 refs.*

The effects of air pollution in Great Britain on health are discussed. No evidence was found from a literature search to suggest that significant damage to health was incurred from the lesser pollutants such as carbon monoxide from vehicle exhausts or from trace element emissions. The major impact of air pollution on health is on the respiratory system, but smoking habits in particular and general social conditions can play a significant role in determining regional variations in morbidity and mortality. There is a high degree of correlation between regional pollution levels (smoke and sulfur dioxide) or regional fuel consumption and bronchitis. In regions of higher air pollution, bronchitis incidence was 2.3 to 1.25 times that in clean areas. It can be assumed that air pollution could be responsible for excess bronchitis in polluted areas of anywhere from 0 to 50% with a median value of 25%. The relationship between lung cancer and air pollution is much more tenuous than that for bronchitis. The national cost of damage by air pollution to health was determined in three areas: economic costs which are reflected by the Gross National Product (GNP), economic costs not reflected in GPN, and social costs.

## 1971

**34057 APTIC NO. 56341**

Friberg, Lars and Gunnar Nordberg

INORGANIC MERCURY - A TOXICOLOGICAL AND EPIDEMIOLOGICAL APPRAISAL. *In: Mercury, Mercurials and Mercaptans. Morton W. Miller and Thomas W. Clarkson (eds.), Springfield, Ill., Charles C. Thomas, June 1971, Chapt. 1, p. 5-22. 39 refs.*

The metabolism and dose-response relationships of inorganic mercury are reviewed, and urine and blood analyses are examined as indicators of exposure and toxic effects. The respiratory route is by far the most important for elemental Mg, and absorption via inhalation is high. The percentage of inhaled Mg taken up by the body in animal experiments has been extimated as high as 75-100%, while a retention of about 75% in humans has been recorded for concentration between 50 and 350 micrograms/cu m of inhaled air. All available data show that practically all Mg is excreted via the urine and feces. A recent and comprehensive study of 567 workers exposed to Mg (more than 90% as mercury vapor) showed a clear dose-related response to Mg exposure for several parameters, including findings and symptoms from the nervous system. High Mg levels lead to a higher probability of Mg poisoning on a group basis; although in the individual case high values of Mg can occur without symptoms, while symptoms can occur in association with low levels of the metal in the urine.

**34058 APTIC NO. 56324**

Grigorowa, R., R. Gohlke, and S. M. Binnewies

A TOXICOLOGICAL EVALUATION OF THE SOLVENT METHYLETHYLTETRAHYDROPYRAN FROM THE OCCUPATIONAL HEALTH VIEWPOINT. *(Zur arbeitshygienisch-toxikologischen Beurteilung des Loesungsmittels Methylaethyltetrahydropyran). Text in German. Z. Ges. Hyg. Ihre Grenzgebiete (Berlin), 17(5):311-317, May 1971. 12 refs.*

The toxicity of a new solvent for high polymers, varnishes, and resins was investigated with rats. The study covered ingestion, percutaneous absorption, and inhalation. The rats were either simply exposed to the action of the solvent, or exposed to the solvent without food. The acute toxicity of the solvent was slight for all three modes of entry. Only absorption by subchronic inhalation produced changes and these were not significant. Association of poisoning and hunger resulted in potentiation of the toxic effect. Methylethyltetrahydropyran should be classified as moderately harmful to health. The following limit values are proposed: for an 8-hr working day, 200 mg/cu m of air; for a single exposure, 600 mg/cu m. Adequate ventilation, respiratory protection, and skin protection must be provided for exposed workers.

**34059** **APTIC NO. 56473**

Jones, H. R.

THE TOXICOLOGY OF MERCURY. *In: Mercury Pollution Control. Noyes Data Corp., Park Ridge, N. J., 24p., 1971. 195 refs.*

Numerous references are cited and described in relation to the toxicological effects of mercury on humans, animals, and plants. Acute Hg poisoning, which can be fatal or cause permanent damage to the human nervous system, has resulted from inhalation of 1200-8500 microgram/cu m of Hg. The more common chronic poisoning (mercurialism) which also affects the nervous system is an insidious form in which the patient may exhibit no well-defined symptoms for a long period of time following exposure. Symptoms usually associated with mercurialism are erethism, gingivitis, and muscular tremors. Correlations have been demonstrated between the Hg concentration in the atmosphere and the prevalence of chronic mercurialism. The ultimate effect of Hg and related compounds is the inhibition of enzyme action, and the major factors that determine the effect of Hg poisoning on humans are amount and rate of absorption, physicochemical properties of the compounds inhaled, and individual susceptibility. Some experiments have indicated that animals have a greater susceptibility to renal tissue damage by Hg vapors than do humans and that this type of data cannot therefore be applied quantitatively to man. The phytotoxicity of vapor from metallic Hg and its compounds in a certain variety of roses and other species of plants has been demonstrated. Although injury to plants has been noticed only when the plants are located in a confined atmosphere containing a source of Hg, yet where the Hg content of the air was less than 10 microgram/cu m severe damage to roses resulted.

**34060** **APTIC NO. 56340**

Kudsk, F. Nielsen

BIOLOGICAL OXIDATION OF ELEMENTAL MERCURY. *In: Mercury, Mercurials and Mercaptans. Morton W. Miller and Thomas W. Clarkson (eds.), Springfield, Ill., Charles C. Thomas, June 1971, Chapt. 21, p. 355-371. 34 refs.*

Processes involved in the absorption of mercury vapor from the lungs of man, in vivo and in vitro uptake of the vapor in human blood, inhibitory effects of ethyl alcohol upon uptake, and possible mechanisms of oxidation of mercury in the blood are presented on the basis of previous investigations. Increasing concentrations of crystalline beef liver catalase have been demonstrated in in vitro experiments to cause a very pronounced acceleration in the rate of uptake of mercury vapor in 3 mM glutathione solutions which were equilibrated with diffusing vapors from metallic mercury and a 1% W/W solution of hydrogen peroxide. The catalase-stimulated rate of mercury uptake is markedly inhibited by 0.2% W/V ethyl alcohol and by increasing concentrations of the catalase inhibitor, 3-amino-1,2,4-triazole. No correlation has been found between the rate of oxidation of glutathione caused by hydrogen peroxide vapor and the rate of mercury uptake. The investigations indicate that primary hydrogen peroxide catalase complex is of major importance in the biological oxidation of mercury. There is further need for investigations to settle which, if any, other enzymes might influence the oxidation of elemental mercury in biological systems. (Author abstract modified)

**34061** **APTIC NO. 56654**

Nadel, Jay a

EFFECT OF AIR POLLUTION ON HEALTH. *In: Combustion-Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 239-244.*

The effects of inhaled air pollutants on the lungs depends to a large extent on the physicochemical characteristics of the material: when gaseous materials are inhaled, the site of their effects depends greatly on the solubility of the gas. Sulfur dioxide is highly soluble and is removed from inspired air in the large conducting airways such that very little of the material reaches the distal airways and alveoli of the lungs. Nitrogen dioxide, on the other hand, is less soluble and reaches the tiny airways and alveoli where is causes damage. Site of deposition and primary action for particulates depends on the size and other physical characteristics of the particles. Sulfur dioxide is the model substance which has its major effect on the airways, and doses which may be too small to be detectable by the subject can cause airway constriction. The consequence may be more serious in patients who already have constricted airways. Aerosol particles are important sources of irritant materials, not only by the nature of the particles but because of their ability to absorb other materials on their surfaces. Carbon monoxide is an important example of a pollutant whose major effects occur after absorption due to its strong affinity for hemoglobin.

**34062** **APTIC NO. 56299**

Nasr, Ahmed N. M.

OZONE POISONING IN MAN: CLINICAL MANIFESTATIONS AND DIFFERENTIAL DIAGNOSIS--A REVIEW. *Clin. Toxicol., 4(3):461-466, Sept. 1971. 27 refs. (Presented at the American Academy of Clinical Toxicology, Annual Meeting, 3rd, San Francisco, Calif., Oct. 22-26, 1970.)*

The diagnosis and treatment of ozone poisoning in man are reviewed. The main effect of O3 intoxication is on the respiratory system. It ranges from irritation of the throat to fatal pulmonary edema and hemmorrhage depending on concentrations and duration of exposure. The manifestation of O3 poisining can stimulate several common diseases. Successful diagnosis depends upon history of exposure, a compatible clinical picture, and results of appropriate clinical studies such as a chest radiograph and an electrocardiogram. There is no specific treatment for O3 poisoning. Symptomatic treatment includes bed rest, oxygen, cough suppressants, analgesics for the headache and chest pain, and antibiotics. The concentration of O3 in the work environment should not exceed 0.1 ppm, the threshold limit value, although a concentration of 0.2-0.3 ppm is objectionable to most people.

**34063** **APTIC NO. 56735**

Padawer, Jacques

PHAGOCYTOSIS OF PARTICULATE SUBSTANCES BY MAST CELLS. *Lab. Invest., 25(4):320-330, 1971. 39 refs.*

Several particulate substances were injected into male Sprague- Dawley rats, after which the animals mast cells were studied by electron microscopy to determine their phagocytic properties. The particulates included colloidal saccharated ferric hydroxide, ferritin, poxvirus, poliovirus; sperm nuclei, and plastic microspheres (the latter in a variety of suspending media). The mast cells were shown to be phagocytic for most of these particles. Shortly after ingestion, the particles became closely associated with the cellular granules, even the mature ones, although only a few granules were involved in any one cell. Particulates that were readily degraded by monocytes were not readily digested by the mast cells. The mast cells were differentially phagocytically active to various particles. (Author abstract modified)

**34064** **APTIC NO. 56304**

Strain, William H., Walter J. Pories, Arthur Flynn, and Orville A. Hill, Jr.

TRACE ELEMENT NUTRITURE AND METABOLISM THROUGH HEAD HAIR ANALYSIS. *Missouri Univ., Columbia, Trace Subst. Environ. Health, Proc. Univ. Mo. Annu. Conf., 5th, Columbia, Mo., 1971, p. 383-397, 1972. 37 refs.*

Measurements on plucked and clipped hair collected from rats at various time intervals after intravenous injection of iodine-131, manganese-54, strontium-85, and zinc-65 showed marked differences in patterns of accumulation for the various radionuclides. Iodine, manganese, and strontium showed a surge of radioactivity into the hair immediately after injection; the surge was followed by an ebbing out from the hair tissue, suggesting hair level relection of the rise and fall of blood levels. The rate of accumulation of zinc was slow initially and demonstrated no surge and ebb response; theis was related to the formation of stable ligands of zinc with the sulfhydryl groups which are abundant in hair. Strontium was the only readionuclide which was easily transferred from hair follicle to hair shaft and was particularly suitable for comparison of uptake by different age groups. The measurements appear to offer possibilities for correlating hair elements with other body pools and for monitoring exposure to toxic concentrations of various metals.

**34065** **APTIC NO. 56763**

Stupfel, Maurice

BIOASSAYS IN THE STUDY OF AIR POLLUTANTS. *(Etude experimentale biologique des polluants atmospheriques). Text in French. Inform. Chim., no. 102:97-102, Dec. 1971. 17 refs.*

General problems involved in bio-assays concerning the study of the effects of air pollutants on the animal, human, or plant organism, are outlined. Highest no-effect doses and LD50 values of air pollutants have not yet been established, and if so, only for a few animal species. Also the combined effects, either acute or chronic, of many air pollutants remain to be studied. Considerable differences in the susceptibility of the test animals to different air pollutants, conditioned by species, age, sex, and environment, are possible. Small mammals, featuring high metabolism rates as compared with large mammal species, are usually more sensitive to air pollutants. The results of chronic poisoning tests on pathogen-free animals may be considerably altered by the so-called chamber effect, as carbon monoxide exposure tests with a test group, another control group, and a so-called absolute control group kept outside the test chamber demonstrated. The meteorologic conditions prevailing during the test may also effect the susceptibility of the animals to air pollutants.

**34066** **APTIC NO. 56343**

Suzuki, Tsuguyoshi, Tai-Ichiro Takemoto, Hiroshi Kashiwazaki, and Tomoyo Miyama

METABOLISM FATE OF ETHYLMERCURY SALTS IN MAN AND ANIMAL. *In: Mercury, Mercurials and Mercaptans. Morton W. Miller and Thomas W. Clarkson (eds.), Springfield, Ill., Charles C. Thomas, June 1971, Chapt. 12, p. 209-232. 40 refs.*

The metabolic fate of ethylmercury salts was studied in man and animals by using methods for estimating the inorganic and total mercury content of biological specimens. The carbon-mercury bond of ethylmercury salts was shown to break very rapidly in male patients transfused with a commercial product of human plasma with 0.01% sodium ethylmercurithiosalicylate and in mice injected subcutaneously or intravenously with ethylmercury chloride or sodium ethylmercurithiosalicylate solution. The increasing level of inorganic mercury and its percentage to total mercury content in the brain were quite distinguishable with post-injection time in mice and resulted in a longer biological half-life time of total mercury than that reported for methylmercury injection. The mercury in red cells from patients was mainly organic, while that of the plasma and urine was inorganic. Only the former showed a rapid decrease with time. (Author abstract modified)

**34067** **APTIC NO. 56674**

Wagner, G.

CANCER DISEASES AND CANCER MORTALITY. *(Krebserkrankungen und Krebssterblichkeit). Text in German. Therapiewoche, 21(9):644-651, 1971.*

Statistical figures are provided on cancer diseases of different organs of the human body and cancer mortality in West Germany and other countries, emphasizing the effects of air pollution and tobacco smoking have on mortality increase. Mortality due to cancer in 1969 was three times more than all the infectious diseases, including tuberculosis. Malignant tumors are the cause of 20% of all deaths, rating second after heart and circulatory diseases. In 1966, the World Health Organization decided to initiate cancer recording on national and regional levels. In West Germany, lung cancer deaths increased in number from 6296 in 1952 to 15,960 in 1965. A comprehensive study of lung cancer in West Europe was made in 1969 by the Working Party on Cancer Statistics. The study showed that over 10 years, the mortality increased by 8% for males, and 3.1% for females, the corresponding figures for West Germany being 8.5% and 3.4%, respectively. The mortality-specific age average is 65 years for men, and 75 for women. The changing environment influences life average and mortality rate. In all European countries the mortality from lung cancer is higher in big cities and on the plains as compared to small towns and mountainous regions. The cause lies in the heavily polluted environment. Traffic police, garage workers, drivers, miners, and workers processing coke and employed at the high furnaces are most exposed. A relationship has been often established between chronic bronchitis and lung cancer. The means of fighting the lung cancer epidemic is to remove carcinogen factors generated by air pollution.

## 1970

**34068** **APTIC NO. 56365**

Fishbein, L., W. G. Flamm, and H. L. Falk

ALKYLATING AGENTS II (EPOXIDES, ALDEHYDES, LACTONES, ALKYL SULFATES, ALKANE SULFONIC ESTERS, AND RELATED DERIVATIVES). *In: Chemical Mutagens. Environmental Effects on Biological Systems. New York and London, Academic Press, 1970, Chapt. 8, p. 198-234. 520 refs.*

An outline and references stressing preparation and/or occurrence, areas of utility, chemical reactions, biological and physical properties, identification and analysis, and mutagenic mode of action in biologic tissues are presented for the alkylating agents: ethylene oxide, propylene oxide, ethylene chlorohydrin, glycidol, epichlorohydrin, di(2,3-epoxypropyl)ether, 1,2:3,4-diepoxybutane, formaldehyde, acetaldehyde, acrolein, chloral hydrate, citronellal, ketene, beta-propiolactone, ethylene sulfide, dimethyl sulfate, diethyl sulfate, methyl methanesulfonate, ethyl methanesulfonate, Myleran, and L-threitol-1,4-bismethanesulfonate.

**34069** **APTIC NO. 56366**

Fishbein, L., W. G. Flamm, and H. F. Falk

ALKYLATING AGENTS I (AZIRIDINES, MUSTARDS, NITROSAMINES, NITROSAMIDES, AND RELATED DERIVATIVES). *In: Chemical Mutagens. Environmental Effects on Biological Systems. New York and London, Academic Press, 1970, Chapt. 7, p. 142-197. 667 refs.*

An outline and references stressing preparation and/or occurrence, areas of utility, chemical reactions, biological and physical properties, identification and analysis, and mutagenic mode of action in biologic tissues are presented for the al-

kylating agents: ethylenimine; triethylenemelamine; Trenimon; TEPA (tris(1eaziridinyl)phosphine oxide; triethylene phosphoramide; aphoxide; APO); metepa; apholate; thio-TEPA; trimethylolmelamine; 2,2-dichloroethylamine; tris(2-chloroethyl)amine; methyl di(2-chloroethyl)amine; methyl bis (2-chloroethyl)amine N-oxide; sulfur mustard; half-sulfur mustard; 2,2-dichloroethyl ether; cyclophosphamide; dimethylnitrosamine; N-methyl-N-nitrosourea; N-methyl-N-nitrosourethan; N-methyl-N-nitro-N-nitrosoguanidine; N-methyl-N-nitroso-p-toluenesulfonamide; 1-nitroso-2-imidazolidone-2 (NIL); diazomethane; cycasin; pyrrolizidine alkaloids; and bracken fern. Selected references to the detection and identification of a mutagen in biological tissues or an environmental parameter (air, water) are given.

**34070** **APTIC NO. 56367**

Fishbein, L., W. G. Flamm, and H. L. Falk

DRUGS, FOOD ADDITIVES, PESTICIDES, AND MISCELLANEOUS MUTAGENS. *In: Chemical Mutagens. Environmental Effects on Biological Systems. New York and London, Academic Press, 1970, Chapt. 9, p. 235-306. 1016 refs.*

An outline and references stressing preparation and/or occurrence, areas of utility, chemical reactions, biological and physical properties, identification and analysis, and mutagenic mode of action in biologic tissues are presented for the alkylating agents: acridines, antibiotics, ethidium bromide, 8-hydroxyquinoline, dithranol, miracil D, steroid diamines, nitrofurazone, lysergic acid diethylamide, caffeine and 8-ethoxycaffeine, cyclamate and cyclohexylamine, ethylenediaminetetraacetic acid, allylisothiocyanate, nitrites and nitrous acid, maleic hydrazide, captan, hemel and hempa, hydrazine and its derivatives, hydroxylamine, N-hydroxyurea, N-hydroxy-1- and N-hydroxy-2-naphthylamines, urethan and N-hydroxyurethan, 4-nitroquinoline-1oxide and 4-hydroxyaminoquinoline-1-oxide, hydrogen peroxide, organic peroxides, aflatoxin, polynuclear aromatic hydrocarbons, metallic salts, and phosphoric acid esters.

**34071** **APTIC NO. 56294**

Muslow, Ike

HEALTH ASPECTS OF AIR POLLUTION. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 21-26, 1970. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

Health aspects of air pollution are reviewed with particular attention to diseases of the lungs caused by the inhalation of dusts. Industrial or occupational occurrence and toxic manifestations are described for various types of pneumoconiosis which include silicosis, asbestosis, anthracosis, berylliosis, byssinosis, farmer s lung, and lead intoxication. The hazard of developing silicosis is determined by several factors which include the proportion of free silica, the size of the dust particles, and the concentration of dust; under conditions commonly seen in industry, silicosis is unlikely to develop before five years exposure. The rapid growth of the asbestos industry places it high on the list of pneumoconiosis. The severity of the disease is often out of all proportion to the x-ray findings. Anthracosis can occur from coal of any type, and patients afflicted with the disease often end up with heart failure secondary to their chronic pulmonary disease. Pulmonary disease may also result from exposure to dust of vegetable origin; among the offenders are bagasse, hay, grain, cotton, flax, and hemp dust. Lead exposure through inhalation manifests itself in symptoms which are systemic rather than pulmonary, while beryllium has produced cases of pulmonary berylliosis.

**34072** **APTIC NO. 56451**

Norris, Berry E.

SELECTED EXAMPLES OF AIR POLLUTION RESEARCH. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 159-168, 1970. 23 refs. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

Selected examples of air pollution research being performed by the Gulf South Research Institute are presented. The projects include: developing a technique for automatically measuring particle size and number employing laser beams; exploring the possible effects of singlet oxygen as an air pollutant by observing its acute and chronic effects upon selected animal tissue cultures and plants, and its reactions with selected biologically and commercially important chemical compounds; and examining the validity and limitations of the in vitro biochemical responses as a technique for the evaluation of toxic effects of air pollutant mixtures using isolated and multiple enzyme systems and synthetic air pollutant mixtures of the photochemical type such as the nitrogen oxide-hydrocarbon air system. The research is ongoing, and results are not yet available.

**34073** **APTIC NO. 56745**

Pierce, James O.

HEALTH EFFECTS OF AIR POLLUTION. *Missouri Univ., Columbia, Coll. of Engineering and Missouri Air Conservation Commission, Jefferson City, Proc. Air Pollut. Conf. Contr., Dusts, Smokes, Noxious Odors, 3rd Annu., 1970, p. B-1 to B-7. (Nov. 17.)*

The effects of air pollution on humans is generally examined. Chemical reactions due to synergism, subtraction, or adaptation can increase or decrease pollutant effects. Several air pollution episodes are described. The effects of the major pollutants, sulfur dioxide, nitrogen oxides, ozone, hydrocarbons, and particulates, are mentioned. Acute and chronic effects of pollution are possible.

**34074** **APTIC NO. 56286**

Schanker, Lewis S.

FLOW OF ENVIRONMENT AGENTS IN REACHING THEIR SITE OF ACTION. *In: Physiology, Environment, and Man. D. H. K. Lee and D. Minard (eds.), Academic Press, 1970, p. 6-14. 10 refs.*

Active and passive membrane transport processes are considered in relation to environmental agents reaching their site of action. Although it is well known that gases, as well as a variety of drugs administered as aerosols, readily penetrate the pulmonary membrane, almost nothing is known about the relative rates at which most substances are absorbed. The respiratory tract boundary is possibly more permeable than some of the other body membranes since substances of low lipid solubility, such as some antibiotic compounds, appear to be absorbed fairly rapidly when administered as aerosols. A substance will most likely penetrate all subsequent boundaries with ease if it can diffuse rapidly across one of the body s external boundaries since most biologic membranes have a number of properties in common, properties which determine their permeability characteristics. Membranes, because of the lipid nature, are highly permeable to lipid-soluble substances, provided that the substances are sufficiently water-soluble to approach the membrane in a molecularly dispersed form. Membranes are also permeable to very small molecules, whether lipid-soluble or not. While body membranes ary of primary importance in regulating the flow of environmental agents through the organism, the binding of solutes to proteins and other macromolecules is also an important factor.

## 1935

**34075** **APTIC NO. 56295**

Pflesser, Gerhard

THE SIGNIFICANCE OF NITRIC OXIDE IN NITROUS GAS POISONING. *(Die Bedeutung des Stickstoffmonoxyds bei der Vergiftung durch nitrose Gase). Text in Ger-*

*man. Naunyn-Schmiedebergs Arch. Pharmakol. Exp. Pathol., vol. 179:545-553, 1935. 1 ref.*

Comparative study of the toxicity of nitric oxide and nitrogen dioxide in white mice is described. Nitric oxide-air mixtures were much more toxic for white mice than identical concentrations of NO2 in air. The maximum ineffective concentrations of NO and NO2 were 0.03% and 0.12% by volume. Also, NO killed the animals four to five times faster than NO2 did. An NO concentration of 0.45% by volume killed the animals in 4 to 5 min. Central symptoms, methemogloginemia, spasms, and cyanosis were the specific symptoms of NO poisoning, while NO2 produced irritation symptoms, lung edema, but no methemoglobinemia.

# EFFECTS-PLANTS AND LIVESTOCK

## 1973

**34076** **APTIC NO. 56584**

Berge, Helmut

RELATIONSHIP BETWEEN TREE PESTS AND IMMISSIONS. *(Beziehungen zwischen Baumschaedlingen und Immissionen). Text in German. Anz. Schaedlingskunde, vol. 46:155-156, 1973. 2 refs.*

In a forest in the vicinity of a large sulfur dioxide emission source, lice were discovered on the species abies concolor and abies veitchi mainly on those needles where injuries from SO2 and hydrogen fluoride exposure were macroscopically and microscopically visible. All abies species whose new shoots were treated with a pesticide until the second half of May showed no injuries on the new 1-year old needles. Non-treated trees showed either injuries or dropped the needles. Contrary to this, mealy bugs on pinus griffithi, pinus silvestris fastigiata and pinus silvestris pumily were mostly found on the non-injured needles and not on those showing macroscopic and microscopic SO2 injuries. Species of Ilex aquifolium uninjured by SO2 suddenly displayed acute injuries after they had been heavily attacked by the fly phytomyza ilicis which coincided with HF concentrations of 6 to 8 micrograms/cu m and half-hourly values of SO2 of 1.5 to 2.0 mg/cu m. Only those treated with an 0.4% Wuxal-solution (six times in 14-day intervals) showed no injuries. Similar results were obtained with a spider mite (oligonychus ununguis) on picea omorika. Through treatment with pesticide, the pests and plant injuries could be averted. The sacchiphantes viridis louse was found in greater concentrations on parts protected from exposure by walls or other plants. The blastethia turionella on pinus montana occurred most frequently on heavily injured parts. The extent of pest occurrence among other things was influenced by weather, season, climatic, orographic, and topographic factors. Through efficient pest control, some injuries can be avoided.

**34077** **APTIC NO. 56637**

Edmunds, George F., Jr.

ECOLOGY OF BLACK PINELEAF SCALE (HOMOPTERA: DIASPIDIDAE). *Environ Entomol., 2(5):765-777, Oct. 1973. 20 refs.*

The ecology of black pineleaf scale which occurs on several species of pine and Douglas fir causing defoliation, discoloration of foliage, and reduced growth is reviewed. All known outbreaks of this scale have been caused by reduction in the population of Prosphaltella parasitoid that normally keeps the scale populations at very low densities. Abnormal mortality of Prospaltella has been found to be caused either by the presence of sorptive dusts or by drift of insecticides. High population densities of scale have been found mainly in areas of high dust fall resulting from industrial sources and roadways. No known causal relationships have been found to exist between atmospheric fluorides and the black pineleaf scale population density. Environmental improvement to conserve the Prospaltella parasitoids appears to be the most effective control measure. (Author abstract modified)

**34078** **APTIC NO. 56625**

Engelbrecht, Abraham H. P. and C. Wynand Louw

HYDROGEN FLUORIDE INJURY IN SUGAR-CANE: SOME ULTRASTRUCTURAL CHANGES. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A157-A159. 8 refs.*

Mature sugar-cane plants were fumigated with controlled amounts of hydrogen fluoride and subsequently microscopically examined for ultrastructural changes. The first symptoms appeared as a fine stippling followed by irregular chlorotic mottling of the leaf margins and tips. These yellow chlorotic areas became necrotic and changed from yellow to brownish-red to dark brown, followed by a complete collapse of the mesophyll cells in the necrotic areas. First symptoms appeared after exposure to 12.9 micrograms/cu m HF; acute symptoms appeared at 23.0 micrograms/cu m; and severe necrotic symptoms and ultimate collapse occurred at a concentration of 105.0 micrograms/cu m. There was an overall decrease in the size of the chloroplasts and membrane system during the development of the chlorotic fluoride injury symptoms and an increase in the size and number of osmiophilic globules. The middle lamellae were swollen and became densely stained. The tonoplast disappeared during the change from reddish-brown to dark brown, and there was a separation of the primary cell walls at the middle lamellae. The plasma membrane disappeared in the necrotic condition, and the ground plasma was very granular. The chloroplasts were smaller than in the dark brown conditon, and the internal membranes as well as the plastid envelope started to disintegrate. Ribosomes were still present in the stroma, and the mitochondria were still intact.

**34079** **APTIC NO. 56515**

MacLean, D. C. and R. E. Schneider

FLUORIDE ACCUMULATION BY FORAGE: CONTINUOUS VS. INTERMITTENT EXPOSURES TO HYDROGEN FLUORIDE. *J. Environ. Quality, 2(4):501-503, Oct.-Dec. 1973. 9 refs.*

The effect of continuous versus intermittent exposures to hydrogen fluoride was investigated with timothy (Phleum pratense L.,) and red clover (Trifolium pratense L.) plants. Fluoride accumulation was greater after continuous fumigations than when the same HF dose was provided in alternate 48 hr exposures. The importance of the intermittent nature of exposures in addition to the pollutant concentration and duration of exposure in governing F accumulation suggests that pollution abatement action to protect livestock from ingested F should be based on the F content of forage rather than the concentration of airborne fluorides. (Author abstract modified)

**34080** **APTIC NO. 56950**

Masuch, Georg, Heinz Weinert, and Robert Guderian

EFFECTS OF HYDROCHLORIC AND SULFUR DIOXIDE ON THE FINE STRUCTURE OF THE CHLOROPLASTS IN SPINACIA OLERACEA L. *(Wirkungen von Chlorwasserstoff und Schwefeldioxid auf the Ultrastruktur der Chloroplasten von Spinacia oleracea L.). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A160-A163. 10 refs.*

The effects of various concentrations of hydrochloric acid and sulfur dioxide in the air on the appearance, and on the ultrastructure of the chloroplasts of Spinacia oleracea L. were studied. Exposure to HCl concentration of 0.13 mg/cu m for 43 hr in 5 days caused no visible symptoms of leaf damage while slight necrosis and chlorosis of the leaves of plants exposed to a HCl concentration of 1.6 mg/cu m for 208 hr in 2 weeks were observed. Microscopic investigations of such leaves revealed an increase in the average frequency of grana per unit stroma surface, and swelling of the thylakoides. Rather uniform organization of the grana, acceleration of the grana formation, both proliferation and enlargement of the osmophilic plastoglobuli, and reduction in the mean frequency of starch granula within the chloroplasts were observed in leaves exposed to HCl concentrations of 0.025 and and 0.13 mg/cu m. Sulfur dioxide in a concentration of 1 mg/cu m necrotized 1% of the total leaf surface in 23 hr. An increase in the average frequency of the grana per unit cross-section area, increase in the amount of plastoglobuli by more than 100%, cumulation of osmophilic granula at the edges of the grana thylakoides, and the presence of granular, osmophilic substances in the loculi of the grana thylakoides were observed in leaves previously exposed to SO2. Clear distinction was made between the degenerative changes produced by HCl and SO2: the HCl-induced increase in the volume and number of plastoglobuli is similar to the natural aging process, while SO2 causes accumulation of granular, osmophilic substances in the loculi and canals of the thylakoides.

**34081 APTIC NO. 56521**

Weinstein, Leonard H., Delbert C. McCune, Jill F. Mancini, and Paul van Leuken

EFFECTS OF HYDROGEN FLUORIDE FUMIGATION OF BEAN PLANTS ON THE GROWTH, DEVELOPMENT, AND REPRODUCTION OF THE MEXICAN BEAN BEETLE. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A150-A153. 16 refs.*

The growth and behavior of Mexican bean beetle populations on control and hydrogen fluoride-fumigated bean plants (P. vulgaris L. ev. predominantly) were investigated to assess the effects of such fumigation on beetle growth, development and reproduction. Beetles that were cultured on HF-fumigated plants were generally lighter than controls, although the occurrence and magnitude of this effect depended upon stage of development, age, and sex of the adult beetle and the number of generations of culture on HF-fumigated plants. A consistently decreased mass of larvae cultured on HF-fumigated plants reflected a delay in development as well as a reduced growth. Larvae from the eggs laid by beetles cultured on HF-fumigated tissue pupated and eclosed three to six days later than controls, and the adults commenced reproductive activity with the same lag in time. Beetles cultured on the fumigated plants also contained greater amounts of fluoride than the controls, and the fluoride content of females was greater than that of males on both HF-fumigated and control plants. Beetles raised on fumigated plants laid fewer egg masses and fewer eggs per mass, although when the first generation was repeated at a later date there was no significant effect. Feeding activity was reduced in both larval and adult stages in beetles cultured on the fumigated plants, and adults showed less flight activity than controls. A difference in color of the elytra was also noted; beetles on HF-fumigated plants were paler than controls.

## 1972

**34082 APTIC NO. 56488**

Chrosciel, Stanislaw, Jan Juda, and Jan Palluch

METHODS OF EVALUATING THE DEGREE OF DANGER TO FOREST ASSOCIATIONS BY CERTAIN SOURCES OF AIR POLLUTION. *(Methodik der Beurteilung des Gefaehrdungsgrades von Waldkomplexen durch Bestimmte Emissionsquellen). Text in German. Mitt Forst. Bundesvers., no. 97:473-479, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

A method is presented for determining the degree to which particular industrial plants contribute to tree-stand damage and for forecasting the degree of air pollution which will arise from projected new emission sources. The problem as a whole has been adapted for calculation by computers. This enables the application of solutions of maximal accuracy and the introduction of a wide range of meteorological coefficients. The question of the proper choice of diffusion coefficients has been solved in an entirely original manner. A method of combined calculations has been developed making use of the forest associations themselves as indices of the spread of pollution. The corrected dose of pollution has been introduced as a measure of the influence of pollution on woods. This is the sum of the pollution concentrations through the relevant periods of time of their occurrence S.t. multiplied by the function f/S.t./. The introduction of the function f/S.t./ is to correct the established dose of pollution in proportion to the degree of damage to the woods. Both initial and calculating formulae are given, as is a computer calculation program.

**34083 APTIC NO. 56413**

Dorn, C. Richard, James O. Pierce, II, Gerald R. Chase, and Patrick E. Phillips

STUDY OF LEAD, COPPER, ZINC AND CADMIUM CONTAMINATION OF FOOD CHAINS OF MAN. (FINAL REPORT). *Missouri Univ., Columbia, Mo., Environmental Protection Agency Contract 68-02-0092, EPA-R3-73-034, 118p., Dec. 1972. 34 refs.*

NTIS: PB 223018

The amount of soil, vegetation, meat, and milk contamination by cadmium, copper, lead, and zinc were estimated on a farm exposed to stack emissions from a lead smelter, lead ore concentrate spillage from trucks, and dust from stockpiled ore at the smelter; these values were compared with those from a farm outside the lead production area. Within 1 year, the lead concentrations in soil samples collected 60 ft, 140 ft, and 220 ft from the highway on the test farm increased 219%, 257%, and 284%, respectively. High lead and cadmium concentrations were found in dust fall and air filter samples from the test farm, and test farm dust fall and soil samples also showed high concentrations of copper. The highest airborne, suspended Cd, Cu, Pb, and Zn concentrations were observed in winter on the test farm; this corresponded with high dust fall, soil, and vegetation levels and the time of greatest increase in lead assimilation by a test cow. There was a general dilution in the lead concentrations at each step of the food chain from soil to cattle tissues on the control farm, while biomagnification of the lead in the grass roots was observed on the test farm. On an equivalent basis, the test cow s blood Pb concentration at the end of the study period was 1/246 the test farm soil concentration and the control cow s blood Pb was 1/187 the control farm soil concentration. The liver, kidney, muscle, and milk of the test cow contained very small amounts of cadmium, and the lead levels were 2.35 micrograms/g, 3.75 micrograms/g, 0.19 micrograms/g, and 13 micrograms/g, respectively. The Pb concentrations in the milk of the test cow were 1.9 times those in the milk of the control cow, and the Pb concentrations in the milk from a cow exposed only to lead ore concentrate spillage from trucks and background sources were intermediate between those of the test and control animals.

**34084 APTIC NO. 56853**

Fer, F., E. Pelz, A. Pferrer, and V. Tollinger

EVALUATION OF THE GROWTH OF GRAFTED SPRUCE PLANTS FROM FUME-RESISTANT CLONES IN THE ERZGEBIRGE FUME-DAMAGE REGION. *(Die Bewertung des Wachstums von Fichtenpfropflingen aus Rauchharteren Klonen im Rauchschadengebiet des Erzgebirges). Text in German. Mitt. Forst. Bundesvers., no. 97:493-509, 1972. 10 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

Problems associated with obtained grafted Norway spruce plants from fume-resistant clones, evaluating their growth, and making practical use of them for afforestation were studied.

The parent trees from which the scion material was taken were selected by external characters in various phases of chronic damage. By grating, six resistant clones and two susceptible clones were produced. The grafted plants, raised outside the fume-damaged area, were planted together with normal plants from the fume damaged area in two plots on the plateau of the Erzgebirge, where the annual sulfur dioxide concentrations average 0.24 and 0.11 mg/cu m of air. As there is no rapid test to determine the resistance of spruce to the effects of SO2, and in view of the natural conditions under which the experiment was conducted, a set of indicators were selected to evaluate the growth of the plants: the increment of the leading shoot, morphological changes in the assimilation organs, sulfur content, ash content, and the weight of 100 1-year and 2-year needles. Data were statistically evaluated to determine any differences between the grafted plants from the fume-resistant and fume-susceptible clones, and the permanence of their properties with time and on different plots. The initial data show that the methods used to select the parent trees, to make the grafts, and to evaluate the growth of the plants are suitable for the purpose. There are no economic or technical reasons why grafted spruce plants from resistant or fairly resistant clones should not be used for afforestation.

**34085** **APTIC NO. 56476**

Greszta, Jan

DAMAGE TO THE ASSIMILATION APPARATUS IN SCOTCH PINE AND THE RESULTANT LOSSES IN WOOD VOLUME INCREMENT. *(Die Beschaedigung des Assimilationsapparates bei der Kiefer Sowie die Dadurch Entstandenen verluste im Zuwachs der Holzmasse). Text in German. Mitt. Forst. Bundesvers., no. 97:431-442, 1972. 8 refs. (Presented at the International Symposium of Forest Fume Damage Experts, Essen, West Germany, Sept. 7-11, 1970.)*

The effects of industrial pollution on the assimilation apparatus and the wood volume increment of the Scotch pine were determined using Hartig s method and Huber s sectional formula. Disks from sample trees in trial plots were felled and disks taken for stem analysis. The data indicated that parallel to the 35 to 50% reduction in the number of needles, there was a reduction in the ages of the needles from 2-3 to 1-2 years; there was a simultaneous reduction in the site class of the stands by two classes. This was a result of 46 to 60% reduction in the diameter increment. If the reduction in needle numbers does not exceed 35%, the reduction in the diameter increment is scarcely 25%. The values vary according to the site category, the concentration of the pollutants, and the duration of their effect.

**34086** **APTIC NO. 56891**

Greszta, Jan and Janusz Olszowski

EFFECT OF POLLUTION FROM THE CHEMICAL INDUSTRY ON THE INCREMENT OF SCOTCH PINE STANDS. *(Einfluss der Chemischen Industrieimmissionen auf den Zuwachs von Kiefernbestaenden). Text in German. Mitt. Forst. Bundesvers., no. 97:163-172, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

The effects of the sulfur dioxide, carbon monoxide, hydrogen sulfide, hydrogen chloride, nitric oxide, barium oxide, boron ore, lithopone, soot, and copper cinders emitted by a chemical factory in the Scotch pine stands growing nearby were studied. In the immediate vicinity of the works, the trees died; both stand density and stem diameter increased with increasing distance from the pollution source. The differences in the site class of the stands near the pollution source (1.2 to 3.8 km distant) amounted to 1.0 to 0.5 site-class units. Compared to the control stands, there differences amounted to two to three classes, depending on the site type. On poorer sites (Scotch pine forest), the difference was smaller, while on better sites (mixed pine forest), it was greater.

**34087** **APTIC NO. 56898**

Haertel, O. and D. Grill

CONIFERA BARKS AS AN INDICATOR OF AIR POLLUTANTS. *(Koniferenborken als Indikatoren fuer Luftverunreinigungen). Text in German. Society for Ecology, Proc. Conf. Load Loadability Ecosystems, Geissen, 1972, p. 153-154. 2 refs.*

Chemical and physiochemical analytical methods for the detection of air pollution from changes in the chemical composition and the physicochemical properties of bark extracts from Conifera are described. Aqueous extracts from Conifera barks feature greatly varying pH values, which makes the detection of sulfur dioxide and other acid pollution impossible. However, close correlation between the electrolytic conductivity of the extracts and the pollutant concentrations was established. In addition, the sulfate content of the extracts can be determined by turbidimetry. A comparison of the measured sulfate contents and the conductivity values permits conclusions on the intensity of non-sulfate pollutant concentrations. Significant increases in the electrolytic conductivity of bark extracts obtained from Conifera due to domestic heating and automotive exhaust emissions were observed. Analyses of the chloride contents in Conifera barks permit the influence of maritime atmosphere to be localized. Spot analysis of extracts was found suitable for the detection of lead, Zn, and magnesium in trees growing in the neighborhood of industrial plants and highways.

**34088** **APTIC NO. 56604**

Houston, D. B. and G. R. Stairs

PHYSIOLOGICAL AND GENETIC RESPONSE OF PINUS STROBUS L CLONES TO SULFUR DIOXIDE AND OZONE EXPOSURES. *Mitt. Forst. Bundesvers., no 97:387-398, 1972. 26 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

The response of eastern white pines (pinus strobus L.) to ozone and sulfur dioxide was studied utilizing controlled fumigation chambers in the greenhouse. The response was judged by preliminary screening tests, repeatability analysis, and biochemical analyses. Tolerant and sensitive clones were fumigated at concentrations of 5, 10, 30, and 60 pphm O3, 2.5, 5, 15, and 45 pphm SO2, and 2.5 pphm SO2 plus 5 pphm O3 in combination. Fumigations were conducted for 6 hours. No damage occurred at 5 pphm O3, while one clone of each class was injured at 10 pphm. At 30 pphm, 60% of the sensitive clones were damaged slightly, and at 60 pphm, 20% of the tolerant and 60% of the sensitive clones were injured. At 2.5 pphm SO2, injury occurred to 20% of the sensitive clones; the tolerant clones were not damaged. All sensitive clones treated with 5 pphm were damaged, while 60% of the tolerant clones developed symptoms. Fifteen pphm injured all sensitive clones and 60% of the tolerant clones. At 45 pphm, all clones were severely damaged. The sensitive clones treated with 2.5 pphm SO2 plus 5 pphm ozone were damaged, but the tolerant clones were unaffected. A repeatability analyses was conducted with 400 ramets in a replicated randomized block design, treated with 2.5 pphm SO2 plus 5 pphm ozone. Analysis indicated that tolerance is under strong genetic control. Thin layer chromatography was performed with phenolic extracts of current years needle tissue from selected individuals. Consistent differences were observed between the two resistant classes. Disc electrophoretic analyses compared sensitive and tolerant foliage extracts for esterases, phenol oxidases, and peroxidases: the resultant profiles showed no differentiation of the resistant classes. (Author abstract modified)

**34089** **APTIC NO. 56590**

Kaleta, Milan

THE EFFECT OF MAGNESITE POLLUTION IN ALTERING PLANT COMMUNITIES. *(Die Wirkung von Magnesit--Immissionen auf die Aenderung der Pflanzengesellschaften). Text in German. Mitt. Forst. Bundesvers.,* *no. 97:569-584, 1972. 14 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

Atmospheric pollution containing large amounts of magnesium oxide alters the soil properties by increasing the pH up to 9.5, increasing the MgO content, mainly in the upper horizons, and greatly inhibiting cellulose decomposition. Alterations in the vegetation of polluted regions are seen in quantitative changes, viz., a reduction in the number of plant species in the phytocoenoses, and in qualitative changes in the structure of the association. The Alopecuretum pratensis Eggler /33/58 association changes as a result of pollution through the stage of Poa pratensis and Festuca pratensis dominance into the successional degradation stage characterized by the species Elytrigia repens Pucciniella distrans. The Arrhenateretum medioeuropeum /Brau-Blanquet 19/Oberdor, 52, and Lolio-Cynosuretum Tx. 37 associations alter as a result of pollution into degradation stages characterized by the dominance of Pucciniella distans. The Caricetum gracilis Tx. 37 association and Caricetum davalianae carpaticum Sillinger 33 alter as a result of pollution into stands with Carex distans being dominant. The Querceto-Carpinetum Tx. 37 and Cephalathero-Fagetum Oberdor, 57 associations alter into degradation stages as a consequence of pollution, and are characterized by the dying of the woody species and by the dominance of an underlayer of Elytrigia repens -- Pucciniella distans--Calamagrosits epigeios.

**34090** **APTIC NO. 56885**

Knabe, Wilhelm

POLLUTION AND ITS THREAT TO FORESTS IN THE RUHR. *(Immissionsbelastung und Immissionsgefahrdung der Walder im Ruhrgebiet). Text in German. Mitt. Forst. Bundesvers., no. 97:53-87, 1972. 30 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

Examples are given of air pollution damage to stands of spruces, pine, and broadleaved species in the forests of the Ruhr region. In the heart of the Ruhr, there are no longer any closed stands of spruce and pine. Although chronic damage occurs to broadleaved and coniferous species in the whole industrial region, the acute damage to the broadleaved species is concentrated in the region containing the chemical factories, aluminum works, galvanizing works, glass factories, and burning tips. The damage is frequently caused by halogen compounds. The causes of chronic fume damage to the forests are sulfur dioxide, fluorine compounds, oxidants, and dusts, the dust affecting the foliage by blocking light and reducing assimilation, and by affecting the roots by accumulating injurious substances in the soil. The danger of pollution to conifer forests in North Rhine/Westphalia is estimated on the basis of an SO2 measurement program, the SO2 being regarded both as an injurious substance and as an indicator of the general air pollution index. The basis for predicting the risk of planting conifers is the frequency of occurrence of certain growing-season mean values. In the heart of the region, a growing-season mean value of 0.08 mg SO2/cu m was exceeded in the last 3 out of 4 years, and, in the marginal areas of the region, it was reached or exceeded in 1 year out of 4.

**34091** **APTIC NO. 56581**

Lampadius, Felix

DAMAGE TO FOREST BY DETERGENT DUST (W-DUST). *(Schaedigung des Waldes durch Waschmittelstaub). Text in German. Mitt. Forst. Bundesvers., no. 97:451-471, 1972. 15 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

Forest fume damage has long been evident in the extensive forest region east of Genthin and is attributable to the pollution from three industrial concerns lying immediately to the west. In the contex of regulations governing the compensation for and prevention of such damage, it is necessary to determine the importance of detergent dust as a phytotoxic substance. Apart from the sulfur dioxide pollution from the three neighboring sources, one of these sources, a detergent factory, also emits a considerable amount of detergent dust. Despite previous opinion to the contrary, the symptoms of damage in these regions and the general damage situation indicate that detergent dust is a cause of plant damage. The fume damage to conifer forests caused by SO2 is different in terms of both symptoms and general nature. The SO2 and detergent dust pollution were determined for 1 year by analyses of the air close to the ground, and dusting tests were made on needles and leaves of various forest trees to determine the phytotoxicity of the dust. After it had been shown that the actual damage to these plant organs was due to the effects of the detergent dust dissolved in water, experiments were conducted in the laboratory and the field. They showed the sensitivity of the individual tree species to the injurious dust; this sensitivity varied as a function of environmental factors. The physiology of the damage process was explained by means of the CZAJA Mnium test.

**34092** **APTIC NO. 56475**

Mamajev, S. A. and O. D. Shkarlet

EFFECTS OF AIR AND SOIL POLLUTION BY INDUSTRIAL WASTE ON THE FRUCTIFICATION OF SCOTCH PINE IN THE URALS. *Mitt. Forst. Bundesvers., no. 97:443-450, 1972. 7 refs. (Presented at the International Symposium of Forest Fume Damage Experts, Essen, West Germany, Sept. 7-11, 1970.)*

The effects of industrial smoke and gases on the seedling intenstiy and quality in pine forests near copper smelting plants in the Urals were studied. The elevated sulfur dioxide content in the atmosphere significantly weakened the Scotch pine stands, thereby lowering the reproductive capacity of the trees. The seed number in the cones decreased, and the ratio of male to female cones and trees changed in favor of the females. The generative organ size of the trees in the smoke-damaged areas also decreased. This was most notable in terms of the ripe cone weight and the staminate cone size. The size of the seeds and pollen grains was characterized by the higher stability grade. The quality of the seeds and pollen grains from trees growing in the smoke-damaged areas was significantly worse than that of the pollen and seeds from trees in non-damaged stands. No specific effects of the smoke damage were observed, with the effects of the smoke on seed and pollen quality being similar to those of natural unfavorable factors.

**34093** **APTIC NO. 56588**

Stefan, Klaus

RESULTS OF NEEDLE ANALYSES FROM A FERTILIZER TRIAL IN A SMOKE- DAMAGED NORWAY SPRUCE STAND. *(Nadelanalytische Ergebnisse von Einem Duengungsversuch in Einem Rauchgeschaedigten Fichtenbestand). Text in German. Mitt. Forst. Bundesvers., no. 97:521-534, 1972. 21 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

To investigate the effect of fertilizing in fume-damaged areas, a fertilizer trial was conducted in 1968 in Aichfild, Steiermark (Austria) in a pole-size Norway spruce stand. The trial area comprised eight plots, of which four remained untreated and four were fertilized with various combinations and amounts of fertilizer. One pair of plots (IV) was on a higher terrace (15 m above the rest of the plots). Nutrients were applied in varying amounts to the plots in the spring of 1969. Needle samples were taken in October of 1968 and 1969. The nitrogen, potassium, phosphorus, calcium, and magnesium content were determined in the first year s needles from two trees in each plot; the sulfur content was determined in the 1 to 3-year needles. As a result of the fertilizer treatment, there was a significant drop in the sulfur content of the 1-year needles (up to 39% relative). In the older needles, the reductions were smaller. The data for the sulfur values for 1968 (plots I through III) and the untreated plots for 1969 (plots I through III) were also evaluted to see how large the deviations of an individual value could be from the area mean value, and to see how this error can be reduced by analyzing more samples and using their mean values. The extent to which the maximum deviations from the area mean value are reduced by this procedure are presented.

**34094** **APTIC NO. 56628**

Steinhuebel, Gejza

THE EFFECT OF SOLID POLLUTANTS ON THE TRANSLOCATION OF ORGANIC SUBSTANCES IN THE GROWING SHOOTS OF CONIFERS. *(Die Beeinflussung der Translokationen organisher stoffe in den Wachsenden trieb durch feste Immissionen bei Koniferen). Text in German. Mitt. Forst. Bundesvers., no. 97:419-430, 1972. 3 refs. (Presented at the International Symposium of Forest Fume Damage Experts, Essen, West Germany, Sept. 7-11, 1970.)*

The effects of solid pollutants may not always be direct. Organs such as young shoots, flowers, and fruits, for example, which rely on the translocation of assimilates from the places where they are produced, are not only directly injured by pollutants, they are also indirectly affected by the inhibition of the translocation of assimilates. The organs supplying the assimilates, which in evergreen broadleaved species and conifers are the photosynthetically active leaves and needles of the previous years, exhibit a reduced rate of photosynthesis due to dust; they are also exhausted by the removal of increased amounts of organic products and fall earlier than normal, even in the absence of toxic pollutants. The increased exhaustion of old dust-coated leaves of broad-leaved species by the translocation of assimilates during the spring extension growth has already been shown, and the experiment on conifers (Abies grandis) has been repeated. In the spring of the current year, the exhaustion of the previous year s dust-coated and nondusty needles of Pinus nigra were determined by means of the modified half-leaf method of Sachs and the modified method of Ivanov and Kossovich.

**34095** **APTIC NO. 56874**

Vins, Bohuslav and R. Mrkva

INCREMENT STUDIES IN SCOTCH PINE STANDS IN THE VICINITY OF A FERTILIZER FACTORY. *(Zuwachsuntersuchungen in Kiefernbestanden in der Umgebung einer Duengerfabrik). Text in German. Mitt. Forst. Bundesvers., no. 97:173-194, 1972. 8 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen West Germany, Sept. 7-11, 1970.)*

Scotch pine stands growing in sandstone in a very dry region of Southern Moravia in the vicinity of a fertilizer factory were studied. Atmospheric pollutants from the plant included sulfur dioxide, sulfuric acid mist, and fluorine compounds. Permanent plots were established in the surrounding pine stands, with the plots being positioned so that the effects of decreasing amounts of pollution could be studied. Ring analyses were made on the cores from 100 sample trees in each of the five plots. Disturbances in the annual ring formation and reductions in growth were noted among the sample trees; similar disturbances were found in the smoke-damaged spruce stands of the Erzgebirge. The structural characteristics and health conditions of the trees were evaluated by computer.

**34096** **APTIC NO. 56892**

Warteresiewicz, M. and I. Szalonek

INVESTIGATIONS ON THE DAMAGE TO CROP PLANTS NEAR A METALLURGICAL COMBINE. *(Untersuchungen ueber die Schaeden an Kulturpflanzen in der Naehe eines Metallurgischen Kombinates). Text in German. Mitt. Forst. Bundesvers., no. 97:209-217, 1972. 10 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

The effect of air pollution on crops was investigated in the vicinity of a large ironworks. The air pollution measurements indicated a high sulfur dioxide level and a high dust content. The unfavorable effect of the pollution on the plants (planted in wooden boxes in uniform soils) was obvious: growth rates were reduced, water loss through the leaves was accelerated, and there were changes in the levels of assimilation pigments. The damage to the plants was irregular and occurred in differing degrees; the number of species suffering damage was high. The yields were lower than among control plants. Losses of up to 40% were sustained by potatoes and fodder beets, although losses of barley were smaller. The lower yields were particularly noticeable in the second year of the experiment, when the incidence of acute damage was very high.

**34097** **APTIC NO. 56285**

MISCELLANEOUS STRESSES. *In: Responses of Plants to Environmental Stresses. J. Levitt (ed.), Academic Press, 1972, Chapt. 20, p. 531-543.*

Various environmental stresses to plants are examined, including such man-made ones as sulfur dioxide, photochemical or oxidant smog involving ozone and peroxyacetyl nitrate, ammonia, and nongaseous chemicals such as herbicides. Such agents can induce both primary and secondary stresses, and the strains produced may be elastic (reversible, e.g., growth inhibition) or plastic (irreversible). Resistance may be due to avoidance (e.g., very waxy leaves prevent penetration of some substances) or to tolerance (e.g., by metabolizing the substances in the cell). Any environmental condition that favors stomatal opening increases the absorption of SO2; while, on the other hand, 1 ppm of SO2 may itself increase the degree of stomatal opening throughout the day and night. The actions of ozone and peroxyacetyl nitrate are of the oxidizing type, while that of SO2 is reducing. The former two injure the lower surface of the leaf, while SO2 injures the upper. Although PAN injury is increased by high light intensity and greatly decreased by darkness, its absorption is unaffected by the opening and closing of stomata. Acid plants are NH3 resistant due to neutralization of the NH3 by their large reserve of organic (N-free) acids stored in the vacuole; whereas amide plants are not resistant due to the absence of this avoidance mechanism. The great majority of plants are of the amide kind and therefore are not NH3 resistant.

**34098** **APTIC NO. 56428**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV(F): THE DAMAGE TO AGRICULTURE. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 140-149. 4 refs.*

The effect of air pollution on agricultural plants and animals in Great Britain is described. Sulfur dioxide can affect life in three ways: as a constituent of the air, as rain, or as acidic mist. Depending on its form, SO2 can affect the soil and the health of the plants, cause delayed blooming, premature senescence, and leaf damage. Smoke reduces the supply of light radiation for photosynthesis and may block the stomatal pores. Fluorine, besides retarding growth in plants as a result of destruction of tissue, can damage animal bone and teeth. Oxides of nitrogen are emitted in relatively small quantities compared to SO2. The oxidizing action of nitrogen dioxide or nitric acid washed out by rain could produce direct damage to foliage. Other pollutants which adversely affect vegetation include lead, ethylene, ozone, and organic sulfur compounds. A discussion on the cost of damage by air pollution to agriculture in Great Britain is included.

## 1971

**34099** **APTIC NO. 56342**

Barber, J., W. Beauford, and Y. J. Shieh

SOME ASPECTS OF MERCURY UPTAKE BY PLANT, ALGAL AND BACTERIAL SYSTEMS IN RELATION TO ITS BIOTRANSFORMATION AND VOLATILIZATION. *In: Mercury, Mercurials and Mercaptans. Morton W. Miller and Thomas W. Clarkson (eds.), Sprinfield, Ill., Charles C. Thomas, June 1971, Chapt. 19, p. 325-345. 21 refs.*

Studies of mercury uptake by plant, algal, and bacterial systems showed absorption of Mg into the roots of Mentha spicata from solutions of mercuric chloride or acetate and small quantities translocated to the leaves but with no evidence that the metal entered the transpiration effluent; on the other hand, Pseudomonas fluorescens and another bacterium isolated from Mg-rich soil were shown to facilitate the volatilization of Mg. Anomalous atmospheric Mg levels detected over heavily vegetated areas associated with Mg-rich soils are thus postulated to be partly due to bacterial action on mercury-containing organic debris. Addition of mercuric chloride at concentrations of .0001 M and above to suspensions of Chlorella pyrenoidosa resulted in a breakdown in the permeability of the cell membrane as indicated by a rapid net efflux of internal potassium. A stimulation of the potassium-potassium exchange across the cell surface without any change in the cytoplasmic level of this cation occurred between .00001 and 5 times .00001 M HgCl2. Maximum stimulation occurred at about 3.0 times .00001 M. Enhancement of the rate of K turnover was associated with a fast component of the Mg uptake which could be removed by washing with cysteine. The Mg stimulated K-K exchange was inhibited by low temperature and by the uncoupler carbonyl cyanide m-chlorophenylhydrazone at 5 times .00001 M. Concentrations below 6 times 10 to the minus 6 M HgCl2 had no effect on the K transport system. (Author abstract modified)

**34100** **APTIC NO. 56655**

Darley, Ellis F.

VEGETATION DAMAGE FROM AIR POLLUTION. *In: Combustion-Generated Air Pollution. A Short Course on Combustion-Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 245-255. 24 refs.*

Principle air pollutants that adversely affect growth and development of vegetation are discussed. The typical injury symptom from peroxyacyl nitrates is a silvering, glazing, or otherwise metallic sheen on the lower surface of affected leaves. The symptoms from various PANs appear to be the same, but as the carbon number of the molecule increases so does the relative toxicity. Injury from ozone results in stippling, mottling, or a chlorosis that is confined to the upper surface of the leaf. Ozone has a similar effect on growth and cell wall metabolism compared to PAN; but, whereas short periods of darkness before, during, and after exposure prevent PAN damage, this is not so with ozone. The hydrocarbon ethylene affects flower production of ornamental species; the dry sepal injury to orchids is a prime example. The chief symptom of acute injury from sulfur dioxide is a white to tan bleaching of leaf tissues; the injury goes clear through the leaf and is not confined to one or the other surface. High concentrations of nitrogen dioxide produce similar effects, although recent experiments with a variety of plants exposed to nitrogen dioxide have demonstrated that concentrations of a few tenths ppm for several weeks can reduce growth as much as 35%. The typical symptomology of hydrogen fluoride poisoning is a necrosis of the margin of dicotyledonous of broad-leaved plants and of the tips of monocotyledonous, parallel-veined plants. Certain cement-kiln dusts have been shown to be toxic to plant leaves when deposited in the presence of free moisture. Dry dusts apparently do not have this affect but may interfere with the normal photosynthesis by the fact that they reduce th light reaching the leaf.

## 1970

**34101** **APTIC NO. 56632**

Paluch, J. and S. Karweta

ZINC AND LEAD IMMISSION IN THE SURROUNDINGS OF A METALLURGICAL COMBINE AND ITS EFFECT OF PLANTS AND SOIL. *Air Conserv. (English translation from Polish of: Ochrona Powietrza), 4(6)(20):5-14, 1970.*

NTIS: TT 70-55124/6

Results of a 5-year study involving the measurement of zinc and lead dust emissions in the surroundings of zinc and lead-producing metallurgical plants and the accumulation of the metals in nearby soil and vegetation are reported. The data indicate the zinc and lead in dusts, expressed as metal precipitate per surface and time unit, have been continually increasing since operational start-up of the various plants in the metallurgical combine. Continual increases in the content of total zinc and lead in the surface layer of soil were found for the period 1966-1969. Effects of the process have so far been limited to the top layer. Fallout of zinc and lead oxides as well as calcium oxide has been found to result in alkalization of the soil; at one site the pH changed from 3.3 to 6.1 over the five year period. Accumulation of the metals in plants has proceeded much more intensely than in soil, and all plants in the region have increased contents of zinc and lead. Lead has increased more intensively than zinc to levels several dozens of times greater than those of 1966. No apparent decrease in yields of plants has yet been noticed.

## 1968

**34102** **APTIC NO. 56255**

Wolfe, R. R., D. P. Anderson, F. L. Cherms, Jr., and W. E. Roper

EFFECT OF DUST AND AMMONIA AIR CONTAMINATION ON TURKEY RESPONSE. *Trans. ASAE (Am. Soc. Agr. Engrs.), 11(4):515-518, 522, 1968. 10 refs. (Presented at the American Society of Agricultural Engineers, Annual Meeting, Saskatoon, Sask., Canada, June 1967, Paper 67-424.)*

The effect of dust and ammonia air contamination on turkey response was investigated in three 12 wk trials. The incidence of airsacculitis at slaughter was significantly affected by the dust air pollution. Increasing the dust contamination from 0.1-0.4 mg/cu ft to 0.6-1.0 mg/cu ft caused more than double the rate of airsacculities. No effect of ammonia concentrations of 0-8 ppm to 20-30 ppm on airsacculitis was detected. Interaction between dust and NH3 was not significant. Mortality rates and feed conversion of the turkeys were not affected by the dust and ammonia treatments. Birds exposed to the high dust and ammonia concentrations showed considerable loss of cilia from the epithelium lining the trachea and an increase in mucus secreting goblet cells. The high dust area caused areas of consolidation to appear in the lungs which would adversely affect their functional capability for oxygen/carbon dioxide exchange. (Author abstract modified)

## 1962

**34103** **APTIC NO. 56671**

Garber, Kurt

RECENT STUDIES ON SMOKE-, DUST-, AND WASTE GAS-INDUCED DAMAGES. PART 2. *(Neuere Literatur* *ueber Rauch-, Staub- und Abgasschaeden II). Text in German. Angew. Botan., no. 36:127- 184, 1962. 607 refs.*

The most recent studies on damages induced by smoke, dust, and waste gas are discussed. The correlation is discussed between the air pollution, the size of the city, and its climate on one hand, and the health of the population on the other hand. The health of the population in industrial regions has been studied. The danger of air pollution to animals and the damages to forest vegetation have been studied. The Air Protection International Conference was held in 1959 in London. Problems of technology, measurements, investigations, research, and setting of standards were discussed. The British Department of Scientific and Industrial Research has been preparing annual reports on research concerning air pollution. In Germany, national and international conferences were held at Tharandt, Bochum, Bad Lippspringe, and Hamburg in 1961. Zieger s work on damages caused to forests had numerous followers. An international meeting of the International Association of Forest Research Institutes was held in Vienna in 1961. The damages caused to agriculture and horticulture were discussed by several researchers. Pollution measurement methods, meteorological factors, pollutants, and other related matters have been studied.

### 1956

**34104** **APTIC NO. 56788**

Edmunds, George F., Jr. and Richard K. Allen

COMPARISON OF BLACK PINE LEAF SCALE POPULATION-DENSITY ON NORMAL PONDEROSA PINE AND THOSE WEAKENED BY OTHER AGENTS. *Proc. Int. Congr. Entomol., 10th, Montreal, Canada, 1956, vol. 4, 1956 (1958).*

A study of an infestation of black pine leaf scale, on ponderosa pine revealed a direct correlation between the degree of damage to the tree and the population density of the scale insects. Tests of the hypothesis that the scale insects more readily attacked trees damaged and weakened from other sources revealed the following: significantly lower average scale population density was noted on trees damaged by boron compounds used as weed killers than in trees not so damaged; no significant difference in average population density was noted between trees with moderate needle tip dieback, presumably caused by uptake of atmospheric fluorides, and trees not showing such damage; no significant difference was found in average scale population density between those trees with relatively high fluoride content and those with relatively low fluoride content; and no difference in average population density of black pine leaf scale was noted between trees damaged by infestations of dwarf mistletoe and trees not so damaged. Hence, damaged and presumably weakened trees are concluded to be no more susceptible to attack than trees not so damaged. (Author abstract modified)

## EFFECTS-MATERIALS

### 1973

**34105** **APTIC NO. 56612**

Frenzel, Gottfried

DECAY OF THE LAST RELICS OF MEDIEVAL GLASS PAINTING. *(Die letzten Zeugnisse mittelalterlicher Glasmalerei im Untergang). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A82-A85.*

Decay of valuable medieval glass paintings in West Germany and in Europe is illustrated by examples, and factors responsible for the decay are discussed. While decay due to natural aging is negligible, since a major decay first has begun some 10 to 20 years ago, deterioration and total decay of glass paintings due to the corrosive action of industrial pollutants has now reached an enormous extent. Sulfur dioxide is chiefly responsible for glass corrosion, and it forms crust on the glass surface, which consists mostly of gypsum and syngenite. Medieval glasses with elevated alkali content are especially susceptible to weathering, which finally results also in an increased susceptibility to air pollutants.

**34106** **APTIC NO. 56614**

Schmidt-Thomsen, Kurt

STONE DETERIORATION AND CONSERVATION IN WESTPHALEN-LIPPE. *(Steinzerstoerung und -konservierung in Westfalen-Lippe). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A93-A97.*

Examples of stone deterioration in historic buildings and statues in Westfalen-Lippe, and possible remedies in conservation are described. Weathering, microorganisms, plants, and air pollutants are the chief causes of stone deterioration. The pronounced acceleration of the rate of stone deterioration during the past decades shows, however, the ever-increasing influence of air pollution on stone materials. Weathering and damaged stones are treated with ethylpolysilicate inalcoholic solution, which is condensed to polysilicic acid under the action of humidity. A combination of ethylpolysilicate with methyltriethoxysilane both strengthens stones and makes them hydrophobic.

### 1972

**34107** **APTIC NO. 56394**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV(D): CORROSION OF METALS. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 113-131.*

The effects of air pollution on the corrosion of metals in the United Kingdom are discussed. The rate of rusting of mild steel, as measured by the depth of attack, increases from 2.3 mil/yr at pollution level of 0.5 mg sulfur dioxide/100 sq cm/lead oxide/yr in a rural area to 4.3 mil/yr in a severe industrial environment with a pollution level of 3.6 mg SO2/100 sq cm/PbO2/yr. Air pollutants have little effect on stainless steel because of the protective oxide film which is corrosion-resistant. In clean environments with low levels of SO2 pollution, aluminum has excellent resistance to atmospheric corrosion. In pure unpolluted environments copper is not prone to atmospheric corrosion, but when SO2 is present, a green patina forms on the surface which is a basic copper sulfate. The rate of formation depends on the SO2 level in the atmosphere but even in severely polluted environments, a coherent film is eventually formed which restricts further attack of the Cu.

**34108** **APTIC NO. 56395**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV(B): THE DAMAGE TO PAINTS USED IN PROTECTION AND DECORATION OF BUILDINGS. *In. An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 90-98. 9 refs.*

The damage of air pollution in Great Britain to paints used in protection and decoration of buildings is discussed. Paint films are affected or damaged by air pollutants in gaseous form, in liquid form when dissolved in rainwater, and in solid particulate form as dust and smoke, which may contain semi-liquid droplets of partially-burned oil. Sulfur dioxide affects paints by increasing the time needed for drying of the film and by attacking the mature dry film, causing loss of gloss. Smoke and dirt produce unsightly deposits on painted surfaces. The results of a survey indicate that in no case was it possible to detect a difference in frequency of repainting which could be related to levels of SO2 or smoke.

**34109** **APTIC NO. 56403**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV(E): THE DAMAGE TO TEXTILES AND OTHER MATERIALS. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 132-139. 3 refs.*

The potential damage to textiles and other materials by air pollutants in Great Britain is described. The two basic effects that pollutants have on textiles are chemical attack from gaseous substances or liquid droplets and soiling from particulate matter. The extent of chemical damage is dependent on the level of pollutants, the duration of exposure, the type and composition of fabric, and humidity. Sulfur dioxide and oxides of nitrogen cause fading of dyestuffs. Acid soot attacks nylon stockings. Premature loss of strength of such substances as leather and cellulosic materials like wood, paper, and cardboard can be caused by acidic attack which causes a breakdown of the fibrous structure. Sulfur dioxide is rapidly absorbed from the atmosphere by these materials with the eventual formation of sulfuric acid. The national cost damage was determined.

**34110** **APTIC NO. 56406**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV(C): CLEANING OF LAUNDRY, HOUSEHOLD GOODS, BUILDINGS, ETC. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 99-112. 14 refs.*

The effect of air pollution in Great Britain on frequency of cleaning different materials is discussed. The three main affected areas are laundry and household goods, building exteriors, and windows. Extra cleaning arises from the deposition of particulate matter, usually dark smoke, though this may be aggravated by other pollutants, such as sulfur dioxide which can cause or promote chemical attack leading to degradation of the affected material. It is the public taste that determines the frequency with which windows and buildings are cleaned, rather than the actual level of dirt deposition. Air pollution is only one of the factors that contribute to the deposits. A table summarizing the excess national economic and social costs in millions of pounds per year of cleaning incurred as a result of having higher levels of pollution in some areas than others is included.

## EFFECTS-ECONOMIC

### 1973

**34111** **APTIC NO. 56908**

Balatskiy, O. F. and V. T. Khaldeyev

THE EFFICIENCY OF GAS CLEANING EQUIPMENT IN CHEMICAL PLANTS. *(Effektivnost sooruzheniya gazoochistnykh ustanovok na predpriyatiyakh khimicheskoy promyshlennosti). Text in Russian. Khim. Tekhnol., no. 4:17-18, 1973. 3 refs.*

The economic efficiency of a complete waste gas cleaning equipment installed in a chemical plant in the USSR is calculated. The equipment, built and installed at an expenditure of approximately $26,000.00, and causing a specific gas cleaning cost of approximately 300 per 1000 cu m, has considerably reduced the gaseous emissions, and consequently the emission-generated health and agricultural damages, as determined from a comparative investigation of the health status of the population and the farm crops before and after the installation of the gas cleaning equipment. The yearly economy deriving from the operation of the waste gas cleaning equipment amounts to approximately $3373.

**34112** **APTIC NO. 56740**

Sagan, L. A.

THE HEALTH COSTS ASSOCIATED WITH THE MINING, TRANSPORTATION AND COMBUSTION OF COAL IN THE STEAM-ELECTRIC INDUSTRY. *Preprint, Palo Alto Medical Clinic, Palo Alto, Calif., 29p., 1973. 40 refs.*

Health costs associated with the mining, transportation, and combustion of coal in the steam-electric industry are examined. An estimated average of 7.9 years of working life are lost per miner as a result of disability due to dyspnea; and calculating 300 working days per year, each day valued at 50 dollars per day, total cost per electrical station per year is $510,750. Coal burned for electrical generation accounts for approximately 8% of the total tonnage of air pollutants and is estimated to be responsible for $357.5 million in health costs for the nation as a whole or approximately $2 million per 1000 megawatt plant. This estimate contains the assumption that all emission sources contribute equally to ground level concentrations and is thus an overestimate. Neverless, accepting 1% of the $357.5 million cost by taking into account the diminishing of ground concentrations of sulfur dioxide as distance from the source increases, the estimated total cost for 180,000 megawatts of coal generated electric power is $3.6 million or $20 thousand per 1000 megawatt electric plant. Data are supplied for cost effectiveness of various improvements in coal mine engineering and of stack versus sulfur removal control, emissions from coal fired electrical generating stations ranked by effect, and annual health costs per 1000 megawatt facility.

**34113** **APTIC NO. 56620**

Tihansky, Dennis P.

COST IMPACT OF AIR POLLUTION CONTROL IN THE AMERICAN STEEL INDUSTRY. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D47-D49. 9 refs.*

The American Iron and Steel Institute estimates that almost $1.7 billion in capital expenditures and $1.0 billion for coke oven gas treatment will be necessary if the American steel industry is to meet proposed air quality standards from 1972 to 1976. Estimates by the Council on Environmental Quality range between $1.7 and $2.4 billion, dependent on future expansion of production facilities. Operation and maintenance costs should increase from $27-$34 million in 1972 to $624-$866 million four years later. Price increases per ton of steel should be in the vicinity of 3.5% after environmental standards (both air and water) are implemented by 1976; after annualization, the impact felt by the consumer will be less than 1% over any one year. Past expenditures were almost equally split between air and water pollution control, whereas recent costs have favored gaseous wastes by 65-80%. Generalizations about air pollution abatement costs are difficult because each mill has its own design, function, and level of operation. Installation costs of controls respond to a number of factors besides waste removal efficiency and design capacity, and the portion of process modification costs attributed to pollution control versus manufacturing is not always apparent. A number of applications have been proposed for waste reuse, although waste recovery does not usually generate revenues.

**34114** **APTIC NO. 56558**

Tinbergen, Wouter

A STATISTICAL SYSTEM FOR THE ECONOMIC QUANTIFICATION OF ENVIRONMENTAL DETERIORATION INCLUDING AIR POLLUTION. *Proc Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D41-D43. 6 refs.*

The description of the functions of the environment and the determination of financial effects of environmental deterioration are being conducted by the Environmental Division of the Netherlands Bureau of Statistics in order to find optimum solutions for environmental problems with the help of modified cost-benefit analysis and to correct the gross national product for environmental effects. Emission data for the Netherlands are being collected in cooperation with the Netherlands Central Planning Office. The work is divided into three parts: stationary sources; transportation; and other sources such as inter alia trans-shipping of materials, process industry, and agriculture. Investments and annual cost for pollution abatement are being determined as far as possible, and the annual cost of increased corrosion caused by air pollution is also being estimated. Emphasis in the program has shifted from economic treatment of environmental problems to the collection of basic data since important data necessary for the investigation are simply not available.

## 1972

**34115** **APTIC NO. 56269**

Syrota, J.

CHAPTER XIV: THE ECONOMIC ASPECTS OF THE WAR ON NUISANCES. *(Chapitre XIV: Les aspects economiques de la lutte contre les nuisances). Text in French. Pollut. Atmos. (Paris), no. special:160-168, July 1972.*

Financing politics in air pollution control, as well as short-term and long-term consequences of nuisance control in industries, are outlined. State aid to manufacturers of air pollution control equipment can be granted in the form of state-sponsored research and development, subventions, loans, and special benefits and alleviations in financing and write-off. Financing air pollution control without state aid will inevitably result in price increases of the products, such as cement, aluminum, and electricity. The non-productive investments for pollution control, estimated now to amount to 1% of the productive investments, will temporarily reduce industrial output, and thus cause price hikes. The long-term subjective effects of efficient pollution control, manifesting, e.g., in a considerable reduction of sulfur dioxide and dust emissions, will be substantially out of proportion to the necessary investments.

**34116** **APTIC NO. 56393**

Dept. of Trade and Industry, Great Britain Programmes Analysis Unit

SECTION IV(H): THE EFFECT ON AMENITY, LAND AND PROPERTY VALUES AND INFRASTRUCTURE. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 173-191. 9 refs.*

The effects of air pollution on amenity, land and property values, and infrastructure in Great Britain are discussed. The effects of industrial pollution on property values vary enormously with the nature of the pollutants, noxious odors are more damaging than smokes. The economic loss to land from air pollution appears as reduced crop yields, poorer milk yields from cattle, or tree damage. The decay of residential areas surrounding industrial sites is accelerated by the cumulative physical and social effects of pollution leading to a different growth and replacement cycle than would exist in a clean environment. Amenity losses to pollution can be estimated at 74 million dollars/yr from smoke sources, 32-550 million dollars/yr from major point sources, and from 1.5 to 12 million dollars/yr from motor vehicles.

**34117** **APTIC NO. 56396**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION IV: DAMAGE CAUSED BY AIR POLLUTION. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 85-89.*

A costing methodology to determine the damage caused by air pollution in Great Britain is calculated. The costs calculated are marginal costs, that is, they derive the extra cost to the nation arising as a result of having one or more areas more polluted than the base clean area. The total cost of pollution will be dependent on the damage incurred in the base clean area. If the form of the damage function is known, then this base figure can be calculated and total costs deduced.

**34118** **APTIC NO. 56404**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION I: TERMS OF REFERENCE AND ECONOMIC APPROACH. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 6-17. 21 refs.*

The terms under which the social and economic costs of air pollution in Great Britain were analyzed are described. A study was sponsored by the Ministry of Technology to obtain and analyze current data. The terms of reference were to define sources and the types of pollutants currently thought to be important, to examine the changes likely to arise from future technological, social, and economic developments, to assess the relevance of current research and development programs, and to suggest the appropriate directions and levels of further research needed to assist in minimizing the total economic and social costs of pollution. Four main categories of costs are considered: physical damage effects, recognizable effects other than physical damage as odor, recognizable effects which produce physical damage, and identifiable effects that are not customarily expressed in monetary terms and that have no defined value.

**34119** **APTIC NO. 56405**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION V: THE COSTS OF AIR POLLUTION CONTROL. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p 199-203. 1 ref.*

The costs of air pollution control in Great Britain for each of the major sources of pollutants is summarized. The current national expenditure on the domestic smoke control program is at the rate of 17 million dollars/yr on 5% of the total black area premises. A summary was published of the expenditure by the industry on air pollution control measures over the period 1958 and 1968. Costs for that period total approximately 1296.7 million dollars. Various studies have been made on fuel oil desulfurization and costs generally are in the range 150-300 dollars/ton of sulfur removed for the reduction in S content from 4% to 1%. The cost for coal desulfurization for a 1000 ton/day plant, including capital and operating changes, is in the range 5-20 dollars/ton of S removed, assuming an S reduction from 2.5% to 1.4%. Carbon monoxide and hydrocarbon emissions from vehicles can be reduced at a cost of 25-50 dollars/vehicle. Lead removal from gasoline would cost consumers 75 million dollars at 1967 consumption levels.

**34120** **APTIC NO. 56408**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

APPENDIX IV: A PILOT SURVEY OF THE EFFECTS OF POLLUTION ON PROPERTY VALUES AND RENTALS IN THE UNITED KINGDOM. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 262-274. 2 refs.*

The results of a pilot questionnaire survey of the effects of pollution on property values and rentals in the United Kingdom are presented. The respondents from the more polluted areas attach, on the average, a greater importance to smoke control influence on property values, both with regard to value attached and with the proportions of respondents considering that there is a real effect. The value attached to a smoke controlled environment increases for both areas with the price of the property. Of 46 responses, 26 named odor as affecting property value. Thirty seven odor sources were mentioned, compared with four solid fallout sources, and four power plants. Industrial plants, sewage works, and gas plants are problems common to most areas.

**34121** **APTIC NO. 56409**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

APPENDIX I: A SIMPLIFIED MODEL OF POLLUTION ECONOMICS AND INTERSECTOR TRANSFERS. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 227-232.*

A simplified model of pollution economics and intersector transfers for Great Britain is presented. The impact of pollution on the direct factors of material consumption, health, amenity, biological damage, control costs, and climate are illustrated. A change in pollution level will either involve or result in changes in all of these factors and involve economic and social costs which will fall initially on several sectors--industry, services, farming, and the individual taxpayer. The effects of changes in pollution level in the costs are traced and the transfer is examined. It is assumed initially that the United Kingdom has a closed economy with no imports or exports of goods or services. It is also assumed that the pollution level is decreased and that factors like amenity and extended life expectancy can have monetary values attached to them.

**34122** **APTIC NO. 56410**

Dept. of Trade and Industry, Great Britain, Programmes Analysis Unit

SECTION VI: SUMMARY AND INTERPRETATION OF FINDINGS. *In: An economic and technical appraisal of air pollution in the United Kingdom. London, H. M. Stationery Office, 1972, p. 204-226. 12 refs.*

The results of an economic and technical appraisal of air pollution in the United Kingdom are summarized. The knowledge of damage functions is limited and the distribution of pollutants is poorly defined. It is estimated that the approximate mean total national economic cost of air pollution could be 950 million dollars/yr of which about 2/3 is probably due to the domestic coal fired. By 1980 the figures should drop to 600 million dollars/yr due to smoke control policies and domestic conversion to low sulfur fuels. Pollution from industrial and electric power generators are costing about 300 million dollars/yr, with 60% due to industrial sources. Motor vehicle pollution costs 87 million dollars/yr. This figure is expected to increase. The largest mean damage costs are in the agricultural and health areas, and these are among the most uncertain.

**34123** **APTIC NO. 56777**

TRW Systems Group, Redondo Beach, Calif. and Scott Research Laboratories, Inc., San Bernardino, Calif.

THE ECONOMIC EFFECTIVENESS OF MANDATORY ENGINE MAINTENANCE FOR REDUCING VEHICLE EXHAUST EMISSIONS CRC EXTENDED PHASE I STUDY INTERIM REPORT. *Air Pollution Control Agency and Coordinating Research Council, Inc., Contract CPA 22-69-087, APRAC Proj. CAPE-13-68, APTD-1072, 93p., Jan. 1972. 10 refs.*

NTIS: PB 209258

The feasibility of controlling exhaust emissions by mandatory vehicle inspection and maintenance was investigated. Exhaust emission quantities were estimated based on a constant volume sampling procedure. The most cost effective inspection interval is approximately yearly and performed in a state lane using the measurement of emission levels under load. The predicted differences in mean emission levels is significant at greater than the 90% level of confidence. The statistically significant emission reductions at a 95% level of confidence are nearly 2/3 of the predicted values. The figure of merit (annularized discounted total program cost divided by the weighted 5-year reductions of emissions) is very sensitive to the relative weighting assigned to hydrocarbons, carbon monoxide, and nitrogen oxides emission reductions and to the extent of imposed maintenance. The figure of merit and emission reductions are highly sensitive to the rate of maintenance deterioration, the effectiveness of voluntary maintenance of ignition misfire and idle fuel to air ratio adjustment and the reliability of the repair. On a percentage basis, emission reductions based upon mass measurements are smaller than those based upon volumetric measurements. On an absolute basis (tons/year), emission reductions based upon mass measurements are slightly greater than those based upon volumetric measurements. When using similar inspection/maintenance procedures, larger percentage reductions for hydrocarbon and nitric oxide and smaller reductions for CO are estimated based upon mass emissions as compared to volumetric emissions. (Author abstract modified)

## 1971

**34124** **APTIC NO. 56706**

Hayslip, Richard M.

ENVIRONMENTAL ECONOMICS. *In: Environment. Southern California Edison Co., Environmental Planning, p. 1-9, 1971. (Complete text not available.)*

Theoretically, pricing structures which reflect social costs will discourage and decrease consumption of residual (pollution) producing goods. The basic principles behind this concept are discussed. Common property resources and the assimilation capacity of the environment are free resources, in our economy. This concept is illustrated considering the production of electrical energy. By applying supply and demand factors to free resources, a value can be placed on them. But because of present limited understanding of interrelationships, the value must be qualitative and not quantitative. Cost/benefit analysis can be used to evaluate capital expenditures for environmental protection. Problems with this type of analysis are discussed. The effects of increased environmental control expenditures on the GNP (gross national product) are discussed.

**34125** **APTIC NO. 56444**

McGraw-Hill Publications, Economics Dept.

POLLUTION CONTROL EXPENDITURES. *In: Economic Analysis and the Efficiency of Government. 92nd Congress, First Session, p. 1273- 1279, July 12 and 19, 1971, (Hearings before the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee Congress of the United States.)*

GPO

A survey was made of the amount of money spent by U. S. businesses in pollution control. The total cost of bringing all of American business existing facilities up to present pollution control standards would be $18.2 billion. American business plants spent $3.64 billion for air and water pollution control in 1971; this represents a 46% increase over 1970. Industry plans to devote nearly $2.1 billion of its pollution control investment to air pollution control in 1971; this represents a 53% increase over 1970. About $1.6 billion is expected to be allotted to water pollution; this is a 37% jump over the amount spent in 1970. Total pollution control spending will account for 4.4% of planned 1971 capital investment by American business; this is compared with 3.1% in 1970. Research and development spending devoted to industry's pollution problems is expected to total $926 million in 1971, a 25% increase over 1970.

## STANDARDS AND CRITERIA

### 1973

**34126** **APTIC NO. 56820**

Inoue, Ichiro

PRESENT STATUS OF NITROGEN OXIDES EXHAUSTION AND MEASURES FOR PREVENTION. *(NOX haishutsu no genjo to sono boshi taisaku). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 9(9):865-870, Sept. 1973. 5 refs.*

Environmental and physical bases for the Japanese nitrogen oxide standards from fixed sources are described. To achieve the standard, NOx concentrations exhausted from fixed sources must be reduced to 1/10th of the present concentration in 8 years (from 300 to 30 ppm). Since such levels cannot be achieved by present techniques, less strict standards have been adopted. The required values are 130-200 ppm for new furnaces and 170-280 ppm for already established ones, depending on the type of furnace and the fuel, except in boilers using solid fuels which have a standard of 480-750 ppm.

**34127** **APTIC NO. 56500**

Inouye, I.

CONTROL AND PROBLEMS OF AIR POLLUTANTS. *(Taiki osen busshitsu no kisei to mondaiten). Text in Japanese. Hyojunka to Hinshitsu Kanri (Stand. Qual. Control), p. 1-5, March 1973.*

Standards of measurement are a problem in determining air quality standards. Japanese air pollution monitoring devices include 497 for dust and sulfur oxides, 104 for nitrogen oxides, 88 for oxidants, 89 for carbon monoxide, and 47 for hydrocarbons. Oil and meteorology are also monitored. The Japanese Industrial Standards and the Japan Environmental Agency provide standard measurement methods. When actual measurements are compared to standard values, an average of several measurements should be taken and a 10% leeway should be given. When it is difficult to obtain samples by the standard method, other appropriate methods should be adopted.

**34128** **APTIC NO. 56624**

Knelson, John H.

THE ROLE OF CLINICAL RESEARCH IN ESTABLISHING AIR QUALITY CRITERIA AND STANDARDS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A71-A73. 2 refs.*

The role of clinical research in establishing air quality criteria and standards; problems associated with epidemiology, toxicology, and clinical environmental research; and the importance of the concepts range of susceptibility and spectrum of response are examined. Environmental criteria and standards have their foundation in human health effects research, but the problems associated with the latter are many. Dose estimates in epidemiology can be calculated from aerometry data obtained in the general vicinity of the study population, but confidence intervals around these estimates are usually large. Disentangling observations on dose response and health effects from other coexisting and uncontrollable environmental covariates such as occupational exposure or meteorologic conditions is also a serious problem. The methods of toxicology are capable of giving the most accurate dose-response relationships for any environmental hazard, but uncertainty always accompanies the necessary extrapolation from animal data to human effects. Clinical environmental research must be maintained at an acceptably low level of risk by holding co-stressors to a level of intensity actually encountered in some areas, exercising great care in simulating environmental conditions, and carefully monitoring the subject's response. Consideration of the concepts denoted by range of susceptibility (within a population) and spectrum of response (in an individual) will allow the construction of a three-dimensional dose-response relationship which can be used to calculate risk factors which reflect the degree of hazard as well as size of the population at risk. The Environmental Protection Agency is working toward this goal in many ways such as its program for Clinical Laboratory Evaluation and Assessment of Noxious Substances (CLEANS).

**34129** **APTIC NO. 56486**

Schlipkoeter, H.-W.

PROBLEMS OF ESTABLISHING THRESHOLD LIMIT VALUES. *(Probleme der Grenzwertfestsetzung). Text in German. Luftverunreinigung, 1973:8-11, 1973. 9 refs.*

The Technical Directives for the Preservation of Clean Air (TAL) contain maximum allowable emission concentrations for nitrogen oxides, chlorine, hydrogen chloride, hydrogen sulfide, sulfur dioxide, and dusts. The VDI guidelines provide additional maximum allowable concentrations for nitric acid and 52 organic substances. All these limit values were worked out in the mid-1960s with the emphasis on plant protection. A revision of them is therefore necessary. A look at maximum allowable concentrations in the U.S.A., USSR, Czechoslovakia, Canada, Poland, and Japan shows that they differ by about three orders or magnitude. In the U. S. primary and secondary standards were established, in West Germany efforts aim at the establishment of standards for the toxic effect and for the annoying effect. A safety factor will have to be included in the maximum allowable concentration. Deriving the maximum allowable concentration from maximum working place concentrations is problematic because they are made especially for the working population between 18 and 65 years old and not for the old and very young whose resistance is much lower. The composition of the emission must be known in order to determine the fractional index from the total quantity.

**34130** **APTIC NO. 56502**

Japan Environmental Agency, Air Quality Bureau

NITROGEN OXIDE EMISSION STANDARD, DEFINED BY AIR POLLUTION PREVENTION LEGISLATION. *(Taiki osen boshiho ni motozuku chisso sankabutsu no haishutsu kijun no settei toni tsuite). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 9(9):958-961, Sept. 1973.*

The nitrogen oxide emission standard set in 1973 is described. It is designed to reduce NOx from large boilers as much as possible using presently available control techniques. The NOx concentration can be calculated by measuring remaining oxygen in the exhaust to prevent dilution of exhaust, which can be easily done to meet the emission standard. The standard is applied to boilers, nitric acid manufacturing plants, and large furnaces. The standard was passed Aug. 10, 1973 and will be applied to nitric acid manufacturing plants in June 1976 and to other plants in June 1965. The NOx should be measured by the phenoldisulfonic acid method.

## 1972

**34131** **APTIC NO. 56795**

Dervay, John R., II, Han Liu, and Gregory Theoclitus

AN EVALUATION OF CURRENT INCINERATOR EMISSION STANDARDS. *American Society of Mechanical Engineers, New York, Proc. Natl. Incinerator Conf., New York, 1972, p. 111-119. 2 refs. (June 4-7.)*

Examination of the three most widely used criteria of incinerator emission determination, i.e., grains particulate/cu ft of dry flue gas corrected to 12% carbon dioxide or 50% excess air and lbs of particulate/hundred lbs (or tons) of waste charged, clearly indicates that correcting the emission to 50% excess air will result in a consistent, representative evaluation of any incinerator, regardless of the composition of the waste consumed. An emission standard based on total mass of particulate emitted per unit quantity of waste charged precludes lowering of the stack emission level through dilution of the flue gas; however, it does not take into account dilution of the waste itself. An emission standard based on a fixed percent of CO2 in the stack gas does not provide a consistent basis since the corrected emission will vary with waste composition. The use of percent excess air as a standard does provide a consistent basis, and it accounts for all combustible material in the waste including unoxidized hydrogen. This is especially important since in common waste the amount of plastics which contain a large portion of free hydrogen is increasing rapidly. A discussion on the determination of an incinerator s burning rate which is implicit to an incinerator s emission level is also presented.

**34132** **APTIC NO. 56452**

National Academy of Sciences-National Research Council, Washington, D. C., Task Group T-65

IMPACT OF AIR-POLLUTION REGULATIONS ON DESIGN CRITERIA FOR BOILER PLANTS AT FEDERAL FACILITIES. (FINAL REPORT). *Commerce contract 2-35765, Technical Rept. 63, 71p., 1972. 47 refs.*

Criteria are presented for boiler performance requirements in relation to the control of smoke and other particulates, sulfur oxides, and nitrogen oxides. Federally owned and operated boilers having a heat-input capacity of from 5 million to 250 million Btu/hr were studied, and regulations concerning the emissions listed above were evaluated to determine their impact on coal-, oil-, and gas-fired boiler plants. Related fuel- and ash-handling operations were also considered in the study. Efficiency curves for various collection devices and cost approximations for determining and achieving compliance with air pollution standards are also provided.

## 1971

**34133** **APTIC NO. 56470**

Jones, H. R.

ENVIRONMENTAL STANDARDS CONCERNING MERCURY. *In: Mercury Pollution Control. Noyes Data Corp., Park Ridge, N. J., 6p., 1971. 29 refs.*

Environmental standards concerning mercury are reviewed. The American Conference of Governmental Industrial Hygienists has adopted a threshold limit value (TLV) of 100 microgram/cu m for Hg vapor and inorganic compounds of Hg for an 8 hr work day. The TLV is based on studies of human exposure in the felt hat industry and in the electronics and lamp industries; however, there are several examples which suggest that this level should be changed. Exposure of workers to a concentration of less than 100 microgram/cu m of Hg vapor and inorganic compounds has resulted in Hg poisoning in 5-12% of those exposed. Other studies of exposure to Hg compounds at twice the TLV dosage for over 2 yr have indicated no evidence of Hg intoxication. No studies have been found that suggest or set a 24 hr exposure limit for Hg in the United States. A 24 hr limit in Russia has been established at 0.3 microgram/cu m based on animal experimentation. An International Symposium has recommended 100 microgram/cu m as the 8 hr maximum allowable concentration for phenyl and methoxyethyl Hg salts. It may be necessary to establish different tolerance levels for particular types of organic Hg compounds.

**34134** **APTIC NO. 56282**

Ulmer, Georges

THE ACTIVITY OF COMBUSTION EQUIPMENT MANUFACTURES. *(Action des constructeurs d appareils de combustion). Text in French. Pollut. Atmos. (Paris), 13(no. special):27-30, Oct. 1971.*

Current requirements on domestic and industrial combustion equipment and fuels are described. While initially a smoke index of 6 (corresponding to the visibility threshold), and a specific dust emission of 0.6-1.2 g/therm have been imposed on combustion equipment, a recent norm draft envisages a smoke index of 4 and a dust emission of 0.4 g/therm for coal-fired boilers with natural draft. Increased fuel and air injection pressures, reciprocal adaptation of burners and combustion equipment, and automation are among the measures taken to improve the design of burner and combustion equipment with respect to pollutant emissions. Combustion-generated emissions are abated through the limitation of non-degassed solid fuels with high volatile content, and of high-sulfur liquid fuel in special protection zones in urban agglomerations. The specific emissions from coal-firing stoves, boilers with natural draft, and automatic boilers has been linked to 0.2-1 g/kg, 1-2 g/kg, and 2-20 g/kg of fuel. The corresponding limits for heating oil and heavy fuel oil are 0.2 and 1-2 g/kg. The specific emission is a function of the fuel volatile content. The sulfur content in heating oil, light and heavy fuel oils No. 1, and heavy fuel oil No. 2 are limited to 0.7%; 2%, and 4%. The nitrogen oxide concentrations in flue gases from heavy oil-firing stoves, central heating boilers, and large-capacity power plants are 20-30 ppm, 50-100 ppm, and 100-500 ppm, respectively.

## 1970

**34135** **APTIC NO. 56736**

Glowiak, B. and P. Kabsch

DUST PRECIPITATION AS A CRITERION FOR EVALUATION OF PUBLIC NUISANCE OF THE PLANNED SOURCES OF EMISSION. *Air Conserv. (English translation from Polish of: Ochrona Powietrza), 4(6)(20):27-34, 1970.*

NTIS: TT 70-55124/6

Polish instructions and regulations on the documentation necessary for affecting preliminary localization of projects for industrial plants emitting dust are examined with some suggested supplements for evaluation of public nuisance resulting from the planned emission sources. The Polish legislation assumes as a criterion of evaluation for a given source the concentration and dust precipitation. This leaves too much freedom with respect to the application of dust collectors and, allows the atmosphere to be saturated with dust up to the permissible values. Other criteria such as permissible emission of dust and height of the source of emission are still missing from consideration of the grain composition of dust and of the background. There should be determinations of the permissible concentration of atmospheric dusts along with the establishment of criteria to settle which dusts be assigned to this group. Permissible amounts of dust precipitated in areas under protection should also be determined with respect to the given month. The establishment of an additional standard in the case of deposit formation is needed for so-called aggressive dusts (offensive to the biological environment).

# LEGAL AND ADMINISTRATIVE

## 1973

**34136** **APTIC NO. 56551**

Bocalandro, Lorenzo Ricardo, Aniceto Torrea, and Jose Rispoli

INDUSTRIAL SURVEY: A PROPOSED METHOD FOR THE SYSTEMATIC ANALYSIS OF AIR POLLUTION. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D20-D23.*

An industrial survey of Argentina was undertaken to determine the extent of pollution due to industrial emissions and to alert industry of the necessity for short and long-term planning. The survey was divided into three parts: physical data concerning the item, region, size, source of emissions, and type of pollutants; economic planning data including expenses and investments; and hygiene (knowledge and regulations). Emission due to combustion was found to be three times more frequent than chemical process emission, and electrical machine manufacturers were the major polluters. Organic components were commoner than inorganic ones, with hydrocarbons being widely spread in comparison with others. The major inorganic pollutants were: carbon monoxide, sulfur oxides, and nitrogen oxides. Air pollution accounted for 24% of the total pollution. Odors were controlled in 50% of the plants, while 30% had no controls. Only 25% of the industries surveyed had made short-term plans, and only 33% had made long-term plans. A copy of the survey questionnaire is included.

**34137** **APTIC NO. 56565**

Boegman, Nico

DEVELOPMENT OF AIR POLLUTION CONTROL POLICY IN SOUTH AFRICA. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D24-D26. 6 refs.*

A summary of the steps taken in South Africa to develop a practical solution to the air pollution problem is presented. According to the Atmospheric Pollution Prevention Act of 1965, every industry which operates a process named in the Act must obtain a registration certificate. In order to qualify for such a certificate, the industry must make use of the best practicable means available to minimize emissions. Failure to maintain and operate such air purification equipment results in cancellation of the certificate, and the absence of a certificate makes the operation of such processes illegal, leading to closure of the operation. The decision on what will be considered the best practicable means rests with the Chief Air Pollution Control Officer. Surveys of air pollutants, rainfall, rivers, topography, and ventilation throughout South Africa have also been conducted, and the results are depicted on maps of the area. Social and economic factors have also been considered.

**34138** **APTIC NO. 56550**

Brenchley, David L.

THE USE OF MANAGEMENT GAMES IN TRAINING AIR POLLUTION CONTROL PERSONNEL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D70-D71. 9 refs.*

The use of management games in the training of air pollution control personnel is examined. Several types of games have been developed for use in training personnel; and these include regular commercial games, case studies and projects using hypothetical situations, role playing, and computer simulations. One of the best commercial games available is a board-type game in which four to eight people can play at one time. It teaches and reinforces the need for cooperation and money in solving environmental problems. Case studies, role playing, and hypothetical situations have been used quite effectively in classroom situations. Probably the most extensive attempt in applying simulation techniques to training is APEX (air pollution exercise); participants play roles of politicians, industrialists, planners, governmental officials, and developers in a computer simulated community. The hypothetical community simulation has been most successful in conjunction with public health short courses and engineering classes. A tabular evaluation of the various types of management games is presented for the following criteria: realism, educational content, number of people involved, simplicity, thinking required, and field tested/low cost.

**34139** **APTIC NO. 56541**

Fukaya Morihei

POLLUTION REGULATIONS AND RELATED PROBLEMS. *(Kogai kisei to koreni kanrensuru shomondai). Text in Japanese. Kemikaru Enjiniaringu (Chem. Eng.), 18(1):23-27, Jan. 1973.*

The harmful substances designated by law at the present time are cadmium and its compounds, chlorine and its compounds, fluorine, hydrogen fluoride, and silicon fluoride, lead and its compounds, and nitrogen oxides. For the harmful substances except nitrogen oxides, the emission standards are already set up. For the nitrogen oxides for which an environmental standard will be set, research and development are needed because techniques of controlling emissions from soot and smoke producing facilities have been almost entirely undeveloped. As for photochemical smog, there are problems of the generation mechanism, measuring methods for essential substances, the effect on human health, ordinary time monitoring, and the arrangement of the forecasting system. On the other hand, as the arrangement of monitoring and measuring systems becomes more and more important by the strengthening of the regulations, the rectification and smoothening of monitoring and measuring are indispensable. For this reason, the standards for sampling, pretreatment, analytical measurement, and calculating methods for each of the pollutants were set and are in force, but further promotion and more expansion are necessary.

**34140** **APTIC NO. 56542**

Goksoyr, Hans

EFFORTS TO IMPROVE THE OSLO AIR. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D27-D29.*

Efforts to reduce sulfur dioxide levels and sulfur emissions resulting from fuel consumption in Oslo, Norway are examined along with some of the resultant effects. Control measures involved conversion from residual fuels of 2 to 2.5% S to distillates of 0.5 to 0.8% S. Theoretical results on the effect of introducing a limit of 300, 500, or 700 tons annual consumption of oil allowed for burning residual fuels indicated drastic reductions of SO2 emissions in the city center, even at low limits for residual fuels. Smallest consumers were approached first and asked to convert to distillate fuels; this measure had a clear positive effect. The main result was, however, that when Oslo acted in the beginning of 1970, a general limit of 700 tons/yr for residual fuels was introduced and residual fuels were not to be used in public buildings. A maximum S level of 0.8% was introduced for distillates. Mean values of SO2 concentrations fell from around 0.35 mg SO2/cu m for the heating seasons 1958/59 1963/64 to less than 0.1 mg/cu m for 1969/70 1971/72.

**34141** **APTIC NO. 56757**

Goodwin, Donald R.

ENVIRONMENTAL PROTECTION AGENCY REGULATIONS AND ENFORCEMENT POLICIES FOR CONTROL OF PARTICULATES. *Air Pollution Control Assoc., Pittsburgh, Pa., Proc. Spec. Conf. Des. Oper. Maint. High Effic. Contr. Equip., St. Louis, Mo., 1973, p. 1-6. (March 29-30.)*

The development of the Environmental Protection Agency (EPA) regulations and enforcement policies for control of particulates is described. The Federal concern for air pollution problems began in the early 1950 s, but was limited to research and technical assistance. By Dec. 1970, direct Federal regulatory authority was provided for the control of mobile vehicle emissions, fuel additives, aircraft emissions, and new stationary source emissions. Unique were the strict time schedules mandated by Congress for the implementation of Federal programs and for Federal cooperation to obtain the state objectives. Some 53 states or territories have adopted general particulate regulations of the process weight type. Industry and government are making joint efforts to control pollution. Industry s representatives serve on the National Air Pollution Control Techniques Advisory Committee to advise on regulatory procedures and to provide emissions and cost data as required by the Clean Air Act. On Feb. 15, 1973, compliance schedules were to be submitted to EPA from all sources covered by regulations designed to achieve the national air quality standards. Industry has spent millions of dollars to purchase and install particulate control equipment. Estimates run as high as $200 million in 1971 alone for the four basic types of particulate control equipment. Industry s next challenge is the control of fine particulates.

**34142** **APTIC NO. 56576**

Heller, K.

THE PRESERVATION OF CLEAN AIR IN THE FIELD OF DOMESTIC HEATING AFTER 9-1-1973. *(Die Luftreinhaltung im Hausbrandbereich nach dem 1.9.1973). Text in German. Luftverunreinigung, 1973:49-54, 1973.*

The eighth ordinance of the emission protection law of the state of North Rhine Westphalia addresses facilities operated with solid fuels from central heaters to individual heaters. Kitchen ranges and bathroom boilers are included. The emission limits set by the ordinance pertain to the concentrations of smoke, soot, and tar. Separate standards have been set for large central heaters with capacities from more than 20,000 kcal/hr to 800,000 kcal/hr and for small individual and central heaters up to 20,000 kcal/hr. A distinction is made between large manually charged and mechanically charged central heaters for which the standards are 150 and 300 mg/cu m. For the smaller units the emission limit expressed as soot-tar number is 200. In both cases the limits can be met by selection of the adequate fuels. These are the low-smoke fuels to which nearly all fuels belong with exception of the various hard coals, hard coal briquettes, gas, and fat coals. Through the replacement of high-smoke coals by low-smoke ones, a reduction of the particulate emission in North Rhine Westphalia from 240,000 t/yr to 60,000 t/yr (75%) is expected. For the entire country it would be 410,000 t/yr. Similar laws exist in other states of West Germany such as Baden Wuerttember, Niedersachsen, Rhineland Palatinate, Bavaria, and Bremen. The Federal Emission Protection Law will see to it that the same ordinance will be passed in the remaining states.

**34143** **APTIC NO. 56642**

Hollinden, Gerald A. and Shirley S. Ray

CONTROL OF NOX FORMATION IN WALL, COAL-FIRED UTILITY BOILERS: TVA-EPA INTERAGENCY AGREEMENT. *Environmental Protection Agency, Research Triangle Park, N. C., Proc. Coal Combust. Semin., Research Triangle Park, N. C., 1973, p. 305-312. (June 19-20.)*

NTIS: PB 224210/AS

An agreement has been formed between the Tennessee Valley Authority and the Environmental Protection Agency to study combustion modification techniques on a field utility boiler for the control of nitrogen oxides and related pollutant emissions from wall, coal-fired utility boilers. The agreement will provide more accurate and detailed engineering design information on the application of specific combustion modification techniques and their effects on NOx and other pollutant emissions, slagging, fouling, corrosion, and general boiler operation and performance for a longer period of time than has been possible in other field tests. (Author abstract).

**34144** **APTIC NO. 56940**

Katz, Morris

INTERSOCIETY COMMITTEE METHODS OF AMBIENT AIR SAMPLING AND ANALYSIS. *Health Lab. Sci., 10(4):339-341, Oct. 1973. 1 ref.*

The twelfth published collection of methods adopted as tentative by the Intersociety Committee of Methods of Ambient Air Sampling and Analysis has been published. With this current presentation, a total of 73 tentative methods are included. Upon the completion of a cooperative test program, the tentative status of a method can be dropped and the method adopted as recommended; thus far, no method has been accepted as recommended. Each method is identified with a number which indicates: pollutant identification, chronological order of adoption of the method for this pollutant, year of adoption of the method, and tentative as opposed to recommended. The Intersociety Committee, which is a joint project of various American professional societies, has as its objective the production of recommended methods of sampling and analysis for routine investigations of air pollution. The participating organizations each appoint a representative to the Intersociety Committee, which serves as a policy-making and editorial board; the work of the Committee is conducted by 10 subcommittees. Originally, the Committee was concerned only with methods for ambient air sampling and analysis; its scope has since been enlarged to include methods for air pollution source sampling and analysis.

**34145** **APTIC NO. 56842**

Merian, Ernest

SOME ENVIRONMENTAL PROGRAMS IN SWITZERLAND. *Chimia, 27(10):521- 523, Oct. 1973. 55 refs.*

About $1000 million or $160 per inhabitant is spent annually in Switzerland on environmental protection, about half of it from public funds and half from private industry. As Switzerland is small, many tasks are carried out on a private basis or semi officially. Approximately $750 million (or $120 per inhabitant) is spent annually on research, about $150 million coming from public bodies and about $600 million coming from industry. Applied research is traditionally carried out mainly in the field of water conservation and, in industry, into the side effects of chemical products. In addition, a group of institutes is concerned with the task of supervision and carrying out measurements in connection with such materials as lead, mercury, halogenated and nonhalogenated compounds, and inorganic gases such as carbon monoxide and sulfur dioxide. The results obtained during studies at the universities and by industry also partially benefit environmental research. With regard to legislation, reference is also made to the results of research in other countries, which are evaluated for this purpose in various places. (Author abstract modified)

**34146** **APTIC NO. 56622**

Norco, J. E. and A. S. Cohen

MODELING EMISSION CONTROL STRATEGIES--THE LONDON LAW IN CHICAGO. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D38-D40. 4 refs.*

A comprehensive modeling system developed to aid the State of Illinois in preparing its stationary source implementation plan for sulfur dioxide and particulates and useful for evaluating the effectiveness of restriction on the use of coal by residential and commercial sources (the London Law) is described. The analytical system is a synthesis of many models and is utilized to formulate, test, and evaluate the effectiveness of various emission control strategies. The dispersion model used for the analysis is a modified version of the Air Quality Display Model (AQDM); this multiple point and area source model computes annual mean, ground level pollution concentrations at up to 237 receptor locations and calculates the effects of each source on each receptor for 480 observed combinations of wind direction, wind speed, and stability class. The forecasting model projects emissions from the utility, industrial, and residential/commercial sectors over a 10-year planning horizon. A control strategy model includes over 100 sulfur dioxide and particulate strategies from which nearly any desired combination can be applied. A major finding of the model was that the best available control techniques applied to industrial and utility sources would not attain federal secondary standards for SO2 and particulates without strict controls on residential and commercial space heating sources. Drastic reduction in the use of coal as a space heating fuel in Chicago and limiting of the sulfur content of oil to 1% by weight was found necessary in order to meet the Federal secondary standards.

**34147** **APTIC NO. 56491**

Olds, F. C.

SOX AND NOX A CRITICAL LOOK AT A CONFUSED SITUATION. *Power Eng., 77(8):32-39, Aug. 1973.*

A critical review of the Clean Air Act Amendments of 1970 and the implementing regulations issued by the Environmental Protection Agency is presented. Technological means for achieving compliance, especially with regard to control of sulfur oxides and nitrogen oxides, appear to have been grossly over-estimated, while the economic, physical, and logistic means for achieving the goals of the amendments were largely absent. The EPA position of setting standards under the Clean Air Act to insure a zero health risk regardless of the economic or social cost has caused much social disruption; and legislators appear to be backing off to a more realistic stance, especially in view of the energy shortage dilemma. The EPA has reassessed its original position on oxides of nitrogen in view of data supporting the view that the Nation s NOx problem is not as severe as once thought. A suit against the Pennsylvania Power Co. for failure to comply with SO2 regulations was dismissed on the basis that no commercially available device existed for solving the problem. Early estimates of all cleanup were less than $50 billion, but by March of 1972 the national cost to meet standards for air, water, and solids was given at $100 billion. Additional control bills have increased that estimate still further.

**34148** **APTIC NO. 56585**

Paulus, John J. and August T. Rossano

SITING OF AIR QUALITY AND METEOROLOGICAL MONITORING STATIONS TO INVESTIGATE AIR QUALITY EFFECTS OF A POINT SOURCE. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C133-C136. 30 refs.*

An approach is presented for locating point source ambient air quality and meteorological monitoring stations when the objective of the station network is to determine compliance with air quality regulations. A plant site instrumented tower could be located within 1 km of the plant, should measure wind speed and direction as near as possible to the level of pollutant emissions, and should not be influenced by aerodynamic effects of plant structures. Air monitoring stations for determining compliance with air quality regulations should be located at points where maximum ground level pollutant concentrations occur. High annual average concentrations seldom occur at the same locations as do the few high short-term concentrations; thus, for example, sulfur dioxide monitoring stations must be located where the highest annual average concentrations occur and also where the highest 24-hour and 3-hour concentrations occur. Atmospheric dispersion models may be used to approximately locate stations, but the dispersion models only provide estimates. The concentrations calculated by a dispersion model can be used to plot concentration isopleths superimposed on a map of the plant area. It may be necessary to have at least two stations for long term concentrations, one at each of the points where the highest calculated concentrations occur. At least one station should be located at each of the two points where calculations indicate that short-term concentrations plus background concentrations will most often total 50% or more of the short-term standard. Station locations should be viewed with suspicion until downwind topography and variations in plume behavior have been considered. Orientation guidelines are also given for instrumentation at the selected sites.

**34149** **APTIC NO. 56611**

Prinz, Bernd

PLANNING AND EVALUATION OF EPIDEMIOLOGICAL SURVEYS ON THE EFFECT OF AIR POLLUTION ON MORTALITY AND MORBIDITY. *(Planung und Auswertung epidemiologischer Untersuchungen ueber den Einfluss von Luftverunreinigungen auf Mortalitaet und Morbiditaet). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A48-A50. 4 refs.*

Mathematic and statistical problems of the planning and evaluation of epidemiological surveys on the effect of air pollution on morbidity and mortality rates are discussed. The selection of homogeneous collectives has the disadvantage that the results will be relevant only for the specific populations selected, while the selection of populations with independent influencing factors may make significance tests impossible. The standardization of comparative collectives causes certain systematic errors to persist, and possibly erroneous interpretation of the results. Differentiation in time and space is equally possible, and so is the selection of random populations. Procedure for the statistical evaluation of epidemiological investigations by means of the x2 test is described. Method for the determination of the magnitude of the population to be covered by an epidemiological survey as a function of an anticipated morbidity and mortality rate and an anticipated influence of air pollution on these rates is given.

**34150** **APTIC NO. 56852**

Prinz, Bernd

FUNCTIONAL MODEL FOR PROTECTION AGAINST IMMISSION IN DENSELY POPULATED AREAS. GREEN BELTS AS RESERVOIRS FOR FRESH AIR. *(Funktionsmodelle fuer den Immissionsschutz in Verdichtungsraeumen. Freizonen als Frischluftreservoire). Text in German. Umwelt (Duesseldorf), 3(5):62-65, 1973.*

A functional model for regional planning is presented which describes the quantitative relationship between emission load, emission density, and regional expansion. Three planning stages are described. In the first stage the following goals must be pursued: the emitting zones may not rise to uncontrolled and unlimited size and shape, the emission density and the total emission may not exceed a certain upper limit, and emitting areas shall be interspersed by sufficiently large green belts for air exchange. In the second stage, a decision is made on the use of the emitting and non-emitting zones. In the third stage, the best possible location for a planned industrial complex or residential area is found. The function of existing green belts is well illustrated by the example of the Ruhr area where, the effect of air pollutants on biological and material objects, and the incorporated mass flow of specific pollutants such as sulfur dioxide, hydrogen fluoride, hydrogen chloride, lead, zinc, and cadmium were determined. A map shows the extent of lichen growth for the period May 15 to November 15, 1972. While in the green belt between the nucleus of the Ruhr area and the Lippe the binding rate of air pollutants approaches zero, the vegetation in the highly polluted area shows 41 kg/sq km sulfur, 82 kg/sq km SO2, 80 kg chlorine, 1 1 kg fluorine, 0.28 kg lead, 0.58 kg zinc, and 0.01 kg/sq km Cd. Questions as which measure to use for the quantitative description of the emission load, how to quantify the emission density, and which tolerance value of the emission load shall be maintained remain to be settled.

**34151** **APTIC NO. 56860**

Quarles, John

CALIFORNIA TRANSPORTATION CONTROL PLAN. *Federal Register, 38(217):31231-31255, Nov. 12, 1973.*

A notice of final rule-making sets forth transportation control plans for the following California intrastate air quality control regions: San Francisco Bay Area, Sacramento Valley, San Diego, San Joaquin Valley, and Metropolitan Los Angeles. The plans are summarized, along with background information and pertinent public comments. Consideration is given the pollution control measures that are being applied generally, why they were chosen, and the respects in which they differ from the measures in the original proposal. These measures are classified under three headings: stationary source controls, hardware controls for vehicles, and VMT reduction measures. The social and economic impact of the controls are discussed.

**34152** **APTIC NO. 56872**

Quarles, John

REQUIREMENTS FOR PREPARATION, ADOPTION, AND SUBMITTAL OF IMPLEMENTATATION PLANS, SUBPART C--EXTENSIONS. *Federal Register, 38(190):27286, Oct. 2, 1973.*

On August 15, 1973, the Environmental Protection Agency promulgated procedural rules governing the conduct of public hearings held pursuant to section 110(f) (2) of the Clean Air Act. In response to several comments regarding these rules, the rules are herein modified. According to these changes: law judges needed to provide over the public hearings will be borrowed from other agencies; the source on whose behalf a section 110(f) postponement has been requested will automatically be made a party to any resultant public hearings; notice of a public hearing will be mailed to the state air pollution control authority having jurisdiction over the source with respect to which the postponement is being requested, the 30-day period within which an interested person may request to be made a party is tied to the date of thy Federal Register notice; the administrative law judge will be allowed 5 additional days to review requests to be made a party; requests to be made a party to the public hearing will be treated as a matter of public record; five copies of all papers, along with the original, should be filed with the regional hearing clerk; and the administrative law judge will be allowed 45 days after the close of a hearing to prepare and file his initial decision with the regional hearing clerk. The procedural rule governing the West Virginia 110(f) public hearing, notice of which is published in this Federal Register, will reflect the changes made herein.

**34153** **APTIC NO. 56594**

Scholl, G. and H. Schoenbeck

STUDIES FOR THE SETUP OF SURVEYS ON THE EFFECTS OF AIR POLLUTANTS IN NORTHRHINE WESTPHALIA. *(Untersuchungen zur Ersetllung eines Wirkungskatasters fuer Luftverunreinigungen in Nordrhein-Westfalen). Text in German. Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. A98-A103. 18 refs.*

The effects of various air pollutants on the thalli of Parmelia physodes, on sapwood of Pinus sylvestris, on the rate of corrosion of iron sheets, as well as the sorption of fluorine, sulfur, chlorine, zinc and cadmium by Lolium multiflorum, and the sorption of sulfur, chlorine and fluorine by a sorption liquid were studied in a 800 sq km area in Northrhine Westphalia to obtain a cadastre on the effects of air pollutants in that area. Differences conditioned by time and localization in the death rates of the thalli of Parmelia physodes, with maxima in highly industrialized zones, and during fall and winter were observed. Intensified coloration of sapwood samples and especially high rates of corrosion with a maximum of 5.32 g of iron per sq m per day in industrialized areas were determined. The Zn, Pb, Cd, Fz, Cl2, and S contents in grass samples were highest in industrial areas. The sorption rates for F2, Cl2, and S were highest in the same areas. Results of such effect surveys can be used for the elaboration of air pollution control measures of prophylactic, preventive, and remedial nature.

**34154** **APTIC NO. 56478**

Stern, Arthur C., Milton S. Heath, and Maynard M. Hufschmidt

A CRITICAL REVIEW OF THE ROLE OF FISCAL POLICIES AND TAXATION IN AIR POLLUTION CONTROL. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D10-D12.*

A critical review of the role of fiscal policies and taxation in air pollution control is presented. The fundamental allocation problem is the proportion of its total resources a nation or community should allocate to the cleaning of its air resource. The determination of what proportion of allocated resources should go into research, training, monitoring, control, enforcement, or other activities is a second step. Finally, it must be determined how these allocated resources should be factored into the governmental and economic system to make them effective. A major allocation problem is whether air pollution control costs incurred at an individual plant should be internalized or externalized; pollution control costs will be resisted if the plant is required to charge these costs to its products. Subsidies and grants are considered by economists to be a less efficient way to accomplish compliance. Taxes have a manifest advantage for pollution abatement only when regulation is relatively ineffective or when tax revenue is earmarked for air pollution control; yet, the earmarked tax tends to be self-perpetuating. Tax remission is undesirable to the extent that subsidies are. Effluent charges and fees have been argued by some as economically attractive and socially desirable because they promote the most efficient means of achieving air quality objective; the argument is yet unproven. Government decisions to apply or remove duties or quotas on the importation, exportation, or production of materials associated with the kind of fuel used has already proven to be a strong influence on air pollution reduction or increase.

**34155** **APTIC NO. 56861**

Train, Russell E.

STATE TRANSPORTATION CONTROL PLANS. *Federal Register, 38(215):30960-30980, Nov. 8, 1973.*

Due to the failure of Massachusetts to submit an acceptable transportation control plan for the metropolitan Boston intrastate region, EPA proposed such a plan. The EPA plan is summarized, its economic and social impact discussed, and pertinent public comments reviewed. Air pollution in the intrastate region, the basis for emission reduction, and EPA efforts to mitigate the effects of the regulations are also discussed. The Ohio transportation implementation control plan is assessed in terms of the state proposed plans for the Dayton and Toledo air quality control regions and the Federally-proposed for the Cincinnati metropolitan region. Due to a failure on the part of Indiana to submit an acceptable transportation control plan, EPA proposed such a plan. The EPA plan has since been deemed insufficient to solve the problem, necessitating a reproposal of the plan. The newly proposed plan is summarized, its air pollution impact discussed, and pertinent public comments solicited. Also discussed are air quality in Indiana, the original EPA proposal, and pollution in the Indiana region.

**34156** **APTIC NO. 56862**

Train, Russell E.

COLORADO; OREGON; MINNESOTA; SPRINGFIELD, MASSACHUSETTS; TRANSPORTATION CONTROL PLANS. *Federal Register, 38(214):30818- 30833, Nov. 7, 1973.*

The original air pollution control transportation and land use plan submitted by Colorado was disapproved. As a result, supplemental information was submitted to correct deficiencies in the original plan. The revised state plan is summarized and its impact discussed. Pollution in the metropolitan Denver region, necessary extensions to the dates set for achieving certain of the primary air quality standards, and additional EPA regulations which may be implemented in addition to the revised Colorado plan are also discussed. The revised Colorado plan is approved. The revised Oregon transportation control plan is also presented and analyzed. Air pollution in the Oregon portion of the Portland interstate region, the implementation schedule, the basis for emission reduction, relevant public comments, and the impact of the plan are discussed. Since Massachusetts failed to submit a transportation control plan for the Massachusetts portion of the Hartford-New Haven-Springfield interstate region, EPA proposed a plan for this region; this plan is summarized, and relevant public comments are reviewed. Air pollution in the interstate region is also discussed. Due to the failure of Minnesota to submit an acceptable transportation control plan, EPA also proposed such a plan for this region. Minnesota later sumbitted a plan of its own, which is hereby approved and the EPA plan withdrawn. The Minnesota plan is presented and discussed in terms of air quality in that state.

**34157** **APTIC NO. 56711**

Woo, Wallace, Salvatore Bellomo, and John Calcagni

STRATEGIES TO REDUCE AIR POLLUTION--THE BOSTON EXPERIENCE. *Preprint, Air Pollution Control Association, 35p., 1973. 4 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 66th, Chicago, Ill., June 24-28, 1973, Paper 73-184.)*

A transportation control strategy for meeting ambient air quality standards is presented for the Boston Air Quality Region. The carbon monoxide and oxidant problem in 1972-1977 within the Boston Region is identified. The CO problem is core-oriented and amendable to solution by transportation control strategies both highway and transit. The oxidant problem is seasonal in nature and is exceeded 10-20 days in that period. It resembles the oxidant problem found in several other Eastern cities. Alternative program packages are described and evaluated with respect to their effectiveness and implementability. The process used in making the decision on the implementation plan is identified. There are gaps in the present institutional structures that deal with implementation of non-capital intensive highway actions. The institutional changes required to implement the transportation control strategies are set forth as a regional traffic management function. (Author abstract modified)

**34158** **APTIC NO. 56547**

Yokoyama, Osayuki

THE DEVELOPMENT OF AN AIR POLLUTION MONITORING SYSTEM. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. C137-C139. 7 refs.*

An Air Pollution Monitoring System (APMS) is described for predicting the sulfur oxides concentration in a newly developed industrial complex in Japan and for providing a rapid and accurate indicator to control source emissions such that the concentration is always kept under a fixed value. The main elements of APMS are: a diffusion simulation model, local weather forecasting model, and a control technique. The diffusion model is classified in three categories: a differential equation model, a plume-puff model, and a statistical model. The differential equation model may be suitable for application to the prediction of SOx concentration when the topography is complex. The plume-puff model is sufficient for prediction in rather flat terrain, and the statistical model can be used as a subsidiary method for these physical models. The particular diffusion model employed by APMS will be determined by the accuracy and cost of prediction. Completion of APMS is scheduled for March 1975. The overall plan envisions the following components: air quality monitoring, stack gas monitoring, source inventory, a synoptic and local weather station, a local forecasting model, data check, error check, contribution calculation, necessity cource control, and the diffusion simulation model.

**34159** **APTIC NO. 56402**

Dept. of Commerce, Washington, D. C.

THE EFFECTS OF POLLUTION ABATEMENT ON INTERNATIONAL TRADE. *98p., April 1973. 91 refs.*

United States and foreign pollution control policies an programs are outlined and their effect on international trade discussed. The countries reviewed are Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, and the United Kingdom. The country profiles summarize each country s pollution problems, environmental awareness, abatement policies and programs, pollution cost, governmental assistance, and future programs. It may be some time before the most substantial cost effects in the U. S. reach the international marketplace in the form of higher prices. Foreign competitive advantages may be due to low foreign levels of pollution control or foreign government actions which subsidize industrial compliance. Each of the nine countries reviewed and the U. S. have adopted the polluter pays principle.

**34160** **APTIC NO. 56713**

Air Pollution Control District, Ventura Calif.

RULES AND REGULATIONS. *Aug. 17, 1973, 78 p.*

The rules and regulations of the Ventura County, California air pollution control board are presented. The 164 rules presented pertain to: definitions, the advisory committee, supplemental rules, the effective date, abbreviations, permits, fees, prohibitions (emission standards), orchard heaters, sampling and testing procedures, the hearing board, and emergency action.

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**34161** **APTIC NO. 56773**

Barnes, Dennis W. and Paul W. Hamelman

ENVIRONMENTAL QUALITY: THE VIRGINIA EXPERIENCE. *Preprint, The Institute of Management Sciences, Providence, R. I., 11p., 1972. (Presented at the Institute of Management Sciences, International Meeting, 19th, Houston, Tex., April 5, 1972.)*

Recommendations were made to establish a Virginia Environmental Study Center (VESC) as a joint undertaking of higher education (State Council of Higher Education for Virginia) and the State government (Division of State Planning and Community Affairs or a new Department of Environment). The general areas of activity proposed for the VESC are: environmental policy analyses and0 su supporting research; determination of consensus on priorities of problems and expectations, as well as development of aggregate indicators of environmental quality and environmental management information systems; and more effective utilization of existing programs, usually federally funded and having environmental quality as a prominent or potential focus. Legislation which would implement the recommendations of the study was presented in the 1972 Virginia General Assembly. Alternatives for state compliance with Federal initiatives, such as the Clean Air Act will be compared and analyzed. (Author abstract modified)

**34162** **APTIC NO. 56605**

Berindan, Cornelia

PUBLIC OPEN SPACES IN POLLUTED CITIES. *(Oeffentliche Gruenflaechen in Staedten mit Luftverunreinigung Augenblicklicher und Zukuenftiger Stand). Text in German. Mitt. Forst. Bundesvers., no. 97:541-567, 1972. 15 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

To study the development of industrial cities, the green open spaces in five Rumanian towns with sources of industrial pollution were investigated. The individual structures of these open spaces were analyzed in terms of high, medium, and low plants and the primary species present. On the basis of the town planning projects, a scheme for the future development of the green open spaces was devised. To establish the growth conditions of the plants, an inventory was made of the pollution due to the chemical, metallurgical, and cement industries, together with specification of their respective pollutant emissions. A pollution spectrum was obtained in which sulfur dioxide was the principal phytotoxic agent. The extent of the polluted areas was also determined. The data show the unfavorable growth conditions of the plants studied, with the trees and plantings being primarily affected and certain flowers being unaffected. Proposals are made for the planning of large areas covered with flowers as a means of improving the well-being of the residents of the industrially polluted communities.

**34163** **APTIC NO. 56886**

Dreyhaupt, Franz-Josef

BASIC PRINCIPLES OF THE CLEAN AIR PROGRAMME OF NORTH RHINE/ WESTPHALIA. *(Grundsaetze des Luftreinhalteprogramms des Landes Nordrhein-Wesfalen). Text in German. Mitt. Forst. Bundesvers., no. 97:89-97, 1972. 3 refs. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

The development of the air pollution problems in North Rhine/ Westphalia and the political principles for solving them are discussed. A large part of the activity of the clean-air movement in the late 1950s was devoted to the air pollution problems that had arisen in the first phase of post-war reconstruction. On the basis of five principles, considerable improvements in air quality were achieved with the aid of new legal regulations. Experience with the clean air program in 1960-1969 has revealed an important new principle, that clean air technology must keep pace with the rapid technological development in production. In this context, efforts are being made to get pollution predictions which will enable the timely preparation of suitable clean air methods for new processing techniques that present novel air pollution problems.

**34164** **APTIC NO. 56887**

Froriep, Siegfried

THE IMPORTANCE OF OPEN (GREEN) SPACES IN THE POLLUTED RUHR AND THE RESULTANT CONSEQUENCES FOR LAND-USE PLANNING IN THE RUHR. *(Die Bedeutung der Gruenflaechen im Immissionsbelastenten Ruhrgebiet und Folgerungen fuer die Landesplanung). Text in German. Mitt. Forst. Bundesvers., no. 97:107-116, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

The Siedlungsverband Ruhrkohlenbezirk (SVR) is the fourth largest urban area in the world, covering an area of 4600 sq km, with a population of 5.5 million people. Apart from its legal obligations in the field of land-use planning, the SVR undertakes other important tasks in the field of landscape care and conservation. Included in the latter are open (green) spaces, which help to improve the climate in the development area, reduce temperature extremes, restore the air, and provide recreational space. Despite the fact that open spaces in urban areas are in danger of being put to other civic or industrial uses, only about 10,000 ha of the SVR s forest area have been lost; the present forest forms 15.5% of the total surface area of the SVR region. Efforts should be made to increase this percentage via the use of marginal land, waste land, tips, spoil mounds, and other unused areas. The regional development plan, drawn up by the parliament of the SVR in 1966 and ratified by the province of North Rhine-Westphalia, is the basic prerequisite for the conservation and shaping of the landscape. Also, the natural landscape is treated as an important prerequisite for recreation outside the central areas. However, a further reduction in the pollution which adversely affects the vegetation is a prerequisite for the conservation of the natural basis of life for man. Environmental hygiene must therefore be included in environmental planning.

**34165** **APTIC NO. 56896**

Karol, I. L. and L. T. Myach

PLANNING A NETWORK FOR THE MONITORING OF THE CHEMICAL COMPOSITION OF PRECIPITATION. *(K planirovaniyu seti stantsiy po izmereniyam khimicheskogo sostava atmosfernykh osadkov). Text in Russian. Inst. Eksp. Meteorol., 1(32):98-110, 1972. 15 refs.*

The problem of the optimization of the density of meteorologic stations for the monitoring of the chemical composition of precipitation is discussed on the basis of systematic monitoring of the sulfate, sodium, calcium, and total ion concentrations of precipitation in the USSR. The correlation function determined for the total ion concentration in the precipitation was close to the correlation function of the precipitation. The criterion according to which the mean-square error of space averaging should not exceed the mean-square random error of the observations, i.e., 0.40-0.45, was satisfied by a station-to-station distance of about 100 km. Monitoring networks of sufficient density should first be set up in highly industrialized and densely populated areas. The station-to-station distance of 1000 km, proposed by the Commission of Air Chemistry and Radioactivity for world-wide pollutant monitoring, is too large.

**34166** **APTIC NO. 56661**

Morin, Bill

CONTROL STRATEGY EVALUATION FOR THE COMMONWEALTH OF PENNSYLVANIA. (FINAL REPORT). *IBM Corp., Gaithersburg, Md., Federal Systems Div., Air Pollution Control Office Contract BOA 68-02-0043, Task 8, 81p., Jan. 31, 1972.*

The adopted Title 25, Rules and Regulations of the Commonwealth of Pennsylvania were applied to the abatement of particulates and sulfur dioxide throughout the Commonwealth. In the Southwest Air Quality Control Region (AQCR), Philadelphia Air Management Regulations were applied to the abatement of SO2 for those sources within the city limits. The air quality resulting from these applied regulations was based upon the Implementation Planning Program diffusion program and proportional modeling. In the remainder of the Commonwealth, air quality analysis was based on straight roll back. No rules and regulations were applied to carbon monoxide and hydrocarbons. However, resultant air quality in nitrogen dioxide was assessed in 1975, 1977, and 1980 based upon proposed (but not adopted) curtailment of oil and gas fired boiler NO2 emission regulations and upon automobile emission reductions. Primary air quality standards for particulates and SO2 were met in the investigated or example regions. Particulate emissions from point sources were dramatically reduced in every example region. The net reduction is usually much less dramatic because a significant portion of the total emissions is from area sources. The coking process in Allegheny County is a special case for both particulate and SO2 allowable emissions. The net percent of sulfur liberated from the coke gas is 10% + 5% (95%) or approximately 15%. Since approximately 25% of the original S in the coal was in the coke gas, 15% of 25% yields approximately 4% of the original S exhausted in the form of SO2 which becomes 8% of the coal S by weight. (Author summary modified)

**34167 APTIC NO. 56260**

Syrota, J.

CHAPTER V: INFORMATION - EDUCATION. *(Chapitre V: L information - la formation). Text in French. Pollut. Atmos. (Paris), no. Special:89-91, July 1972.*

Problems and possibilities of information and education in matters of environmental protection and air pollution in France are outlined. Apart from the publicity granted environmental concerns by mass media, a permanent traveling exhibition has been operated by the Association for the Prevention of Air Pollution (Association pour la Prevention de la pollution atmospherique). Mass information may help eliminate biases in the public opinion on the real meaning of air pollution, which is commonly held now as a threat to human health, while in reality is not more than a nuisance. General and special courses are being organized for officials responsible for air pollution problems in industry and science. Aerosol physics and air pollution has been adopted as a major subject at Paris University. Air pollution-related aspects of combustion processes are increasingly emphasized in different engineering courses. Heat engineers are to attend special courses as a requirement for licensing.

**34168 APTIC NO. 56261**

Syrota, J.

CHAPTER VI: THE RESEARCH UNDERTAKEN. *(Chapitre VI: La recherche entreprise). Text in French. Pollut. Atmos. (Paris), no. special:92-97, July 1972.*

The research activity presently pursued in France by a variety of scientific and other institutions is surveyed. The effects of air pollutants on populations in industrial and urban centers, as well as on animals are studied mainly by I.N.S.E.R.M. (Institut national de la sante, des etudes et de la recherche medicale), in collaboration with university departments in Paris, Lille, Toulouse, and Bordeaux. The research conducted by I.N.R.A. (Institut national de recherche agronomique) and C.E.R.A.F.E.R. (Centre national d etudes techniques et de recherches technologiques pour l agriculture, les forets et l equipement rural) are concerned with the action of fluorine-contaminated forage on domestic animals, the general effects of pollutants on vine, feed crops, grains, orchards, and other cultures, as well as with pollution-resistant species. The effects of air pollutants on materials, in particular metals, are studied by S.C.T.B. (Centre scientifique et technique du batiment). The physiochemical characterisitcs of air pollutants are studied by O.C.D.E. (Organisation de Cooperation et de Developpement Economique), I.N.S.E.R.M. and IRCHA (Institut national de recherche chimique appliquee). Pollutant diffusion in pragmatic and analogous models, as well as possibilities of pollution forecast, are investigated by SOGREAH (Societe grenobloise d etudes et d applications hydrauliques). Other research is concerned with the desulfurization of fuels and flue gases, the improvement of the combustion conditions with respect to the reduction of the nitrogen oxide and unburned emissions, high-temperature filters, clinker burning kiln-emitted dust separation, dust separation techniques for oxygen converter units, smoke capture techniques for cokery furnaces, fume capture techniques for aluminum electrolyzers, and the separation of sulfuric manufacturing generated exit gases.

**34169 APTIC NO. 56262**

Syrota, J.

CHAPTER VII: THE REGULATIONS IMPOSED IN FRANCE. *(Chapitre VII: La reglementation en France). Text in French. Pollut. Atmos. (Paris), no. special:98-103, July 1972.*

The regulations imposed on air pollutant emissions in France from the start of such legislative activity until the present time are surveyed. Successive legislations implemented in France relative to combustion equipment-generated emissions apply to combustion equipment even of small capacity, especially in particularly pollution-prone areas. The crankcase hydrocarbon emissions are limited to 0.15% of the total fuel consumption. The carbon monoxide emissions from four-stroke gasoline engines at idling speed are limited to 4.5%. Drafts on particulate emissions from combustion equipment, on the design for chimneys for domestic heating equipment, and on the qualification of heaters are being elaborated.

**34170 APTIC NO. 56263**

Syrota, J.

CHAPTER VIII: COMMENTS ON LEGISLATIONS IN FOREIGN COUNTRIES CONCERNING AIR POLLUTION. *(Chapitre VIII: Apercu sur des legislations etrangeres relatives a la pollution atmospherique). Text in French. Pollut. Atmos. (Paris), no. special:104-117, July 1972.*

In Great Britain, the application of the best applicable means has been adopted as a basic policy in air pollution control. In West Germany, the present limit imposed on exhaust gas carbon monoxide concentrations, will be reduced by 50% by 1975. The maximum allowable non-toxic dust concentration is limited to 150 mg/N cu m. The use of desulfurized or sulfur-free gaseous fuels, desulfurization of flue gases, and proper heat insulation of buildings are envisaged for sulfur dioxide emission control in West Germany. The gasoline lead content will be reduced to 0.40 g/l before 1972, and further to 0.15 g/l before 1977. Maximum allowable air pollutant concentrations as adopted in different countries such as Italy, Finland, France, Japan, Switzerland, Sweden, Czechoslovakia, USSR, Belgium and West Germany are compared.

**34171 APTIC NO. 56264**

Syrota, J.

CHAPTER IX: DETERMINATION OF A POLICY OF THE WAR ON AIR POLLUTION. *(Chapitre IX: Determination d une politique de lutte contre la pollution atmospherique). Text in French. Pollut. Atmos. (Paris), no. special:118-120, July 1972.*

General principles on which to base a reasonable policy of air pollution control are outlined. Since the quantitative estimation of the costs and the benefits the community will derive from air pollution control measures is both impossible and unjustified, the war on air pollution should be set on an empirical basis. In this policy, the preservation of public health should have absolute priority. Therefore, critical pollution levels beyond which health hazards occur should carefully established. A further objective should be the elimination of nuisances, caused either directly by specific air pollutants and malodorous emissions, or indirectly through the deterioration and depreciation of property. The introduction of modern, ecologically acceptable technologies in new, and possibly also in existing, industrial plants should be regarded as a major preventive measure in the war on air pollution.

**34172 APTIC NO. 56268**

Syrota, J.

CHAPTER XIII: FINANCIAL INCENTIVES. *(Chapitre XIII: L incitation financiere). Text in French. Pollut. Atmos. (Paris), no. special:155-159, July 1972.*

General problems of financial incentives, such as taxation and regulatory measures, in air pollution prevention or abatement are discussed. The incitation for air pollution emission control through the imposition of taxes, e.g., such as on fuels depending on their sulfur content, is hardly applicable, as such a tax might equalize the prices of low-sulfur and high-sulfur fuels. Instead, the price gap between low-sulfur and high-sulfur fuels should be modified. The financial incentives in the form of taxes are usually inconvenient due to the fact that air is an unlimited resource, and that the pollutant concentrations around emission sources are in no relation to the actual amount of the emissions. Meteorological factors, specific dispersion conditions, and stack height all influence the siutation. Consequently, there is no valid, objective criterion upon which to base taxes. Regulatory measures, rigid by definition, have to be periodically updated in view to technological and economic changes.

**34173** **APTIC NO. 56589**

Tesar, Vladimir

THE AIR-POLLUTION SITUATION, FORESTRY, AND THE EFFECT OF COUNTER-MEASURES IN THE TRUTNOV (RIESENGEBIRGE) FUME DAMAGE REGION. *(Immissionssituation, Forstliche Lage und Auswirkung von Gegenmassnahmen im Immissionsgebiet Turtnov/Riesengebirg). Text in German. Mitt. Forst. Bundesvers., no. 97:481-491, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany Sept. 7-11, 1970.)*

The polluted region in the southeast foothills of the Riesengebirge (beech/silver fir zone from 370 to 740 m altitude) was studied as a model after the installation of a power station in 1957. Study of the ecological relations between the forest and sulfur dioxide pollution, of the pattern of forest damage in time and space, and of the effect on yield formed the basis for solving the pollution problem in forestry. The study has been going for 10 years at three different levels: the fundamentals of the type and effect of individual silvicultural measures are being studied on trial plots; these are then tested on selected stand complexes, both as regards time and spatial aspects; and all the forestry results are evaluated in the context of the whole management unit of almost 4000 ha affected by pollution in comparison to neighboring undamaged management units. The objectives of management are then modified, and a form of high-forest management suitable for the pollution conditions is developed. The greatest importance is attached to the management of Norway spruce trees (75% of the forest area). Accordingly, it is impossible from the management angle, and also undesirable because of yield reduction, to give up the growing of spruce altogether. Therefore, efforts were made to limit the degree and extent of conversion in order to make forestry which in fume damaged regions aims first and foremost at maintaining forest) more profitable. The criteria, the silvicultural techniques, and the management organization presented herein represent a means of doing so.

**34174** **APTIC NO. 56450**

National Academy of Sciences, Washington, D. C., Committee for International Environmental Programs

INSTITUTIONAL ARRANGEMENTS FOR INTERNATIONAL ENVIRONMENTAL COOPERATION. *Dept. of State Contract 1722-120012-SCC-10118, 87p., 1972.*

Recommendations and alternatives are set forth for the construction of a worldwide system of environmental protection. The proposals presented are intended to identify more adequate institutions for policy formation and management and are focused directly upon issues among the principal agenda items of the 1972 United Nations Conference on the Human Environment. Concepts considered include: the global environment and the national interest; basic institutional choices, structural and procedural changes in the United Nations system; an environmental science advisory and research board; a monitoring and surveillance network; a world environment fund; and the strengthening of trans-national environmental capabilities. Prominent among those specialized agencies of the United Nations which are currently active in the environmental field is the World Meteorological Organization which concerns itself with many aspects of air pollution and climatic change in connection with the World Weather Watch and the Global Atmospheric Research Program.

**34175** **APTIC NO. 56633**

Great Britain Dept. of Trade and Industry

APPENDIX V. LEGISLATION AS A SOCIAL INDICATOR. *In: An Economic and Technical Appraisal of Air Pollution in the United Kingdom. Chilton, England, Her Majesty s stationary office, 1972, p. 275-285.*

Representative legislation on amenity and safety matters in Great Britain are summarized. The time is limited to the period since 1800 covering the effect of the industrial revolution with regard to the environmental problems it created and the metal attitude and the technological means of solving them. Different problems became important at different times in history: animal diseases, 1848-1866; pharmaceutical control, 1850s; explosives, 1869-1874; and public health 1846-1875.

## 1971

**34176** **APTIC NO. 56380**

Dahlberg, Duane A.

A MULTIINSTITUTIONAL AND INTERDISCIPLINARY ENVIRONMENTAL APPROACH. *Inst. of Environmental Sciences, Mt. Prospect, Ill., Proc. Inst. Environ. Sci., Annu. Tech. Meet., 17th, Los Angeles, Calif., 1971, p. 305-308. 2 refs. (April 26-30.)*

The establishment and aims of a multiinstitutional and interdisciplinary environmental community organization are described. The North Central Environmental Council are organized in the spring of 1970 in the Fargo-Moorehead community. The aims include: the gathering from all sources of information and data affecting the environment; the establishment of educational programs through local schools, service groups, extension programs, and news media; the development of research programs for environmental improvement; and the providing of environmental consultation service.

**34177** **APTIC NO. 56284**

Lee, E. G.

INTERNATIONAL LEGAL ASPECTS OF POLLUTION OF THE ATMOSPHERE. *Univ. Toronto Law J., 21(2):203-210, 1971. 11 refs.*

Effective international measures of atmospheric pollution control are no longer dependent on technological research but instead on institutional structures for the decision-making process. Special legal principles must be developed which take cognizance of the nature of the atmosphere as a physioeconomic unit which cannot be destroyed through intersection by various jurisdiction frontiers. Regional air shed areas might be established based on meteorological and topographical studies, on source and nature of existing pollution and its effects, and on taking into account other factors such as economic resources population concentration, and existing and expected land use patterns. Also, some form of international authority might be established to enforce air pollution control programs within the air shed region without regard to existing lines of political demarcation. The Trail Smelter arbitration and the Corfu Channel case are illustrations of the international responsibility to forbid and refrain a state from acts which would cause injury or damage to persons or property outside its territory.

**34178** **APTIC NO. 56659**

Maga, John A.

COMBUSTION-GENERATED AIR POLLUTION. LEGAL ASPECTS. *In: Combustion-Generated Air Pollution. A Short Course on Combustion- Generated Air Pollution held at the University of California, Berkeley, September 22-26, 1969. Ernest S. Starkman (ed.), New York-London, Plenum Press, 1971, p. 319-335. 8 refs.*

The legal basis for preventing air pollution is reviewed and federal, state, and local legislation and programs are outlined. An individual can seek relief from air pollution in courts on the basis of the common law of nuisance; although nuisance action is not a practical way of preventing the discharge of contaminants from a large number of sources, requiring solutions which are not obvious, or correcting problems caused by poor operation of facilities or equipment. Enabling legislation required to control emissions should be constructed to: specify the conditions and procedures to be followed in activating the agency; designate the areas to be included; provide for the powers of the agency, including the authority to adopt and enforce rules and regulations and to carry out the provisions of the act; provide for the governing board, appointment of officers, and hiring of employees; include standards for the emissions of some of the more common pollutants; provide for funds required by the agency; provide for appeals from the administrative actions; and establish the means of enforcing the emission standards, rules, and regulations.

**34179** **APTIC NO. 56348**

Schaefer, Vincent J.

THE MEASUREMENT OF AEROSOL PARTICLES ON A GLOBAL SCALE. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 28, p. 365-368. 4 refs.*

A measurement of Aitken nuclei (submicron particles) provides an excellent index of the degree of air contamination in a given area. Thus, short-term (2 to 4 week) measurements of Aitken nuclei should be made at key locations throughout the world to help determine whether present attempts at air pollution control can reverse the trend toward air pollution on a global scale. Such measurements are easily made using instruments like the highly portable Gardner Small Particle Counter or the new Rich Counter. During the past 4 years, Aitken, cloud, lead, and natural ice nuclei have been measured over the Atlantic Ocean and on a continental scale over North America. The establishment of a global observation program that could be operational in less than a year is proposed. The basic pattern would consist of a band of stations extending around the Northern Hemisphere within 42 to 45 deg of latitude; seven additional stations are scattered throughout the United States: and 21 Coast Guard stations and at least 10 moving vessels are under consideration. The immediate deployment of a global network of sedimentation foils to be exposed for month long periods is recommended to supplement the Aitken nuclei measurements.

**34180** **APTIC NO. 56379**

Sheng, Henry P.

A FRESH LOOK AT ENVIRONMENTAL TECHNOLOGY CURRICULUM FOR JUNIOR COLLEGES. *Inst. of Environmental Sciences, Mt. Prospect, Ill., Proc. Inst. Environ. Sci., Annu. Tech. Meet., 17th, Los Angeles, Calif., 1971, p. 302-303. 8 refs. (April 26-30.)*

A 2-year curriculum program for educating environmental technologists is presented. The emphasis is on a general, interdisciplinary environmental/ecological education. Among the courses are 22 hours on environmental technology which includes a laboratory and lecture course on air quality control. This course covers air pollutants, their sources, and their control. The student will be able to follow the laboratory procedure to collect the samples and analyze the constituents by various techniques.

**34181** **APTIC NO. 56270**

Spofford, Walter O., Jr.

DECISION MAKING UNDER UNCERTAINTY: THE CASE OF CARBON DIOXIDE BUILDUP IN THE ATMOSPHERE. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 46, p. 537-556. 11 refs.*

Decisions regarding possible future damages related to current practices of modern society will be made by politicians within the decision making institutions. Thus, both uncertainty as to the actual occurrence of a future catastrophic event and the unusually long times before these events are expected to occur tend to decrease the probability than any major action will be taken at this time. If decision makers are to commit large amounts of resources to remedy the problem of carbon dioxide buildup, it will be necessary to: know more about the rate of CO2 buildup in the environment, including the capacity and locations of various CO2 sinks; to know more about the effects of various ambient concentrations of CO2 on the climate; to have a better idea of the time scale when certain environmental changes might be expected to occur; to have a reasonable estimate of the necessary lead times required to convert a society from processes that generate CO2 as residuals to processes that do not; and to estimate the necessary lead times required to develop alternative processes for converting energy from other fossil fuels. In the case of CO2, this will be made possible only through additional research and monitoring.

**34182** **APTIC NO. 56273**

Warren, David G. (ed.)

OFFENSIVE ODORS -- ANOTHER POLLUTION PROBLEM. *Health Law Bull., no. 23:1-7, April 1971. 27 refs.*

Nuisance laws for odor control, though not totally unworkable as a device, are difficult and inefficient. The problem with all legal approaches is that of finding a supportable definition of offensive odors, one which will find acceptance as restricting those odors which are unwanted as well as unhealthful, unsafe, or nonesthetic. The ordinances of several North Carolina cities are possibly helpful but probably deficient in enforcement effectiveness. The State s air pollution control laws could be broadened to include odor as a controllable contaminant. The most accessible tool at present for fighting odor pollution is education of the public and encouragement of voluntary abatement of industrial and residential odors. New scientific techniques and devices, developed in harmony with legal requirements, as needed to detect and measure the presence of odors deemed offensive to the public. (Author conclusions modified)

**34183** **APTIC NO. 56389**

Commission for Air Chemistry and Radioactivity

STATION NETWORKS FOR WORLDWIDE POLLUTANTS. *In: Man s Impact on the Climate. William H. Matthews, William W. Kellogg, and G. D. Robinson (eds.), Cambridge, Mass., MIT Press, 1971, Chapt. 16, p. 239-245.*

The need is increasing for a worldwide monitoring network to define regional and global trends in atmospheric pollution. In deciding which constituents shall be monitored, the constituents can be considered in terms of their residence time or the effects to be expected from them. Present knowledge is insufficient to assign priorities to the various pollutants proposed for worldwide monitoring. The second important planning variable is the number or density of the monitoring stations. The density of a network is always a compromise between costs and adequate data coverage. A good network should be dense enough to assume regionally and globally representative data and to establish any natural sources and sinks, and the stations should be put in the best logistically feasible locations. The network for long lived species should take advantage of the similarity between the different species of both the anthropogenic and natural sources and sinks. To monitor seasonal and regional variations adequately, the minimum number of stations for carbon dioxide and constituents of similar character is about 10; several others would be needed to assess longitudinal differences. For short lived species, consideration must be given to the distribution of sources, the vertical mixing of air, the removal mechanisms and their rates, and the general climatological situation in the region of the station. A spacing of about 1000 km is proposed for the short lived constituents; approximately 100 stations would be needed to achieve this spacing. In addition to surface monitoring stations, some permanent sampling by aircraft and balloons should be considered, especially in the stratosphere. It is necessary to start at the outset with one or more pilot stations where the equipment can be tested under operational conditions; it is also essential that for a given constituent the same measuring technique be used at all stations.

**34184** **APTIC NO. 56417**

Council of Europe

RESOLUTION NO. 2. POLLUTION AND WASTE DISPOSAL. *Preprint, p. 3-4, 1971. (Presented at the Council of Europe, 2nd Symposium of Members of Parliament, Specialists in Public Health, Stockholm, Sweden, July 1-4, 1971.)*

The Consultative Assembly of the Council of Europe is invited to recommend, through the Committee of Ministers, that the governments of the member states develop pollution control and prevention through systematic application of existing knowledge and experience; create adequate scientific, technical, legal, and institutional bases for comprehensive programs of pollution control and prevention; promote the development of technologies which produce minimal harmful environmental effects; promote research into environmental pollution and control methods, establish environmental quality criteria, guides, and standards for various types of environmental pollution; organize surveillance, monitoring, and early warning systems on a regional, national, and international basis; seek international agreement to prohibit unsafe dumping at sea; take national and international action to prevent coastal pollution; enact appropriate legislation to forestall harmful or undesirable effects of pollution; and provide proper incentives to stimulate action on the lines recommended herein.

### 1970

**34185** **APTIC NO. 56292**

Mathews, Dean S.

THE REGIONAL APPROACH--AIR RESOURCES MANAGEMENT. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 1-11, 1970. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

The regional approach to air resource management is reviewed. The intent of the Federal Clean Air Act and the policy of the National Air Pollution Control Administration is that air pollution be attacked as an individual problem in each Region of the country and that it be attacked by a combination of State and appropriate local governments guided by explicit desires of the public in the Region. The intended primary role of the Federal Government is to provide information and assistance to the States and to local governments and to make certain that the machinery of the Act operates at peak efficiency. The major ingredient in the effectiveness of State and local action will be the attitudes of public officials and citizens. Over 91 consultations have been conducted for Air Quality Control Regions in every State and Territory of the United States, and more than 57 Air Quality Control Regions have been completed in their designation procedure. Included are flow diagrams for action to control air pollution on a regional basis under the Air Quality Act, for the designation of air quality control regions, for use of modeling in the development of implementation plans, and of the Air Quality Control System.

**34186** **APTIC NO. 56293**

Parker, Vernon C.

THE LOUISIANA AIR CONTROL PROGRAM. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 12-16. 1070. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., Oct. 8-9, 1970.)*

The Louisiana Air Control Program is described with particular attention being given to the interrelationship between the Air Control Commission and the State Health Department, the air monitoring program, state-wide emission inventories, new regulations, and Federal Air Quality Control Regions. The director of the Bureau of Environmental Health of the State Health Department is the Technical Secretary of the Air Control Commission, and the employees of the State Health Department are the working arm of the Commission. The Air Control Program has fixed sampling stations in all of the major metropolitan areas of the State, and various sampling devices are additionally set up in special study areas or areas where air pollution problems are suspected. A mobile trailer-laboratory can be used in virtually any location and can sample for almost any type of pollutant as necessary. Estimates are provided for percent contribution of the State s major sources of air pollution.

**34187** **APTIC NO. 56693**

Shell, H. D.

STATUS OF STATE AIR POLLUTION CONTROL REGULATIONS. *Missouri Univ., Columbia, Coll. of Engineering and Missouri Air Conservation Commission, Jefferson City, Proc. Air Pollut. Conf. Contr. Dusts, Smokes, Noxious Odors, 3rd Annu., 1970, p. D-1 to D-10. (Nov. 17.)*

The Missouri Air Conservation Law provided for the formation of the Missouri Air Conservation Commission which could then grant exemptions to local governments to carry on their own air pollution control programs, privided the local ordinance is as stringent as state regulations. Three local programs are underway in the St. Louis Metropolitan Area, the Kansas City Metropolitan Area, and the Springfield-Greene County Area. The rural, out-state area is covered by Regulation S-I controlling automobile emission inspections, Regulation S-II requiring reporting of new installations, Regulation S-III restricting open burning, and Regulation S-IV regulating incinerators. Proposed regulations include S-V restricting particulate emissions from industrial processes, S-VI giving maximum allowable emissions of particulates from fuel burning equipment used in indirect heating, S-VII preventing emissions of wind-borne particulates, S-VIII restricting visible emissions, S-IX restricting odorous emissions, and S-X restricting sulfur compound emissions. Several amendments to the Missouri Air Conservation Law are needed regarding hearings, permits, and penalties.

## SOCIAL ASPECTS

### 1973

**34188** **APTIC NO. 56579**

Babcock, Lyndon R. Jr. and William A. Thomas

USE OF AIR QUALITY INDICES IN THE UNITED STATES. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D64-D66. 1 ref.*

Questionnaires were mailed to 1100 previous recipients of an air pollution index in order to determine public use and response to such indices. The largest use by far was that of informing the public about air quality through written and electronic mass media. The chief complaint was that the index describes a condition in the past and therefore could not be incorporated easily into a common format, such as used in weather predictions. The second most common difficulty encountered was that the numerical index does not describe the effects of the corresponding atmospheric condition on human health. A frequent complaint was that the public confuses the air quality index with visibility, without regard to meteorological conditions that may be predominating. Another problem found was that the index often is applied to large geographical areas serviced by an inadequate number of monitors. A possible solution to most of these problems might be a standardized news release with the individual pollutant concentrations are listed along with the index for that time period and an adjective describing the air quality in relation to federal standards. Pollutants that contribute most to the index would be noted along with their source. Announcement of monitoring times and locations and explanations for fluctuations due to meteorological or other reasons would also be helpful.

**34189** **APTIC NO. 56543**

Mason, Robert G.

IMPACT OF AIR POLLUTION ON THE ATTITUDES AND KNOWLEDGE OF URBAN RESIDENTS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D60-D63. 4 refs.*

Results are presented from the testing of an air quality communication model in which public attitudes and knowledge play a role. The model stipulates that four endogenous variables, attitudes toward air quality, exposure to mass media information about air quality, knowledge about air quality, and level of interpersonal discussion about air quality, are interdependent. Two urban communities of approximately 100,000 population each were selected for the testing. Analysis of the results indicates the development of a single communication process that is divided into stages. Initially, the issue may be poorly perceived or defined, those with more positive attitudes toward the topic interacting or discussing it more with peers. The passage of time and the accumulation of information from the mass media leads to higher levels of knowledge. Mass media use is no longer selective, i.e., it is not a function of attitude level. Finally, interdependence between mass media use and knowledge suggests a sufficiency of information about air quality in mass media channels and that the more knowledgeable people are actively seeking out this information. Inaccurate or inconsistent public statements are likely to be challenged.

**34190** **APTIC NO. 56863**

Morgan, M. Granger, Barbara Rose Barkovich, and Alan K. Meier

THE SOCIAL COSTS OF PRODUCING ELECTRIC POWER FROM COAL: A FIRST ORDER CALCULATION. *Proc. IEEE (Inst. Elec. Electron. Engrs.), 61(10):1431-1442, Oct. 1973. 65 refs.*

A methodology is discussed for quantitatively computing the social costs, or external diseconomies, which result from the production of electric power in conventional coal-fired steam electric plants. With the available and the present level of understanding, it is possible to obtain preliminary numbers which place the social cost for the technology of the mid and late 1960 s at greater than or equal to 11.5 + or 2 mills/kWh, somewhat more than the price of bulk power at the plant bus bar. In applying controls to limit the social costs, control costs are incurred. If the optimum level of control is taken as that level at which the sum of the social costs and the control costs is minimum, then the total social and control costs with optimum control are estimated at greater than 4.5 + or 1.5 mills/kWh and the costs of controlling to that level as greater than 3 + or 1 mills/kWh. These numbers will probably be reduced, and the optimum levels for control increased, as new technologies are developed. Significantly, most accurate estimates of the social costs of coal-fired electric generation will require large improvements in data, especially in the areas of air pollution and land use costs, as well as some fundamental conceptual progress in techniques for treating value orientation. (Author abstract modified)

### 1971

**34191** **APTIC NO. 56707**

Cramer, Engene N.

LIFE QUALITY TOPICS. *In: Environment. Southern California Edison Co., 1971, 117p.*

A reference and teaching text for the Environmental Education Program at the Southern California Edison Co. is presented in question and answer form on customer and news media inquiries concerning aesthetics and land usage, air pollution in general, smog reactions, weather and meteorology (inversions, smog, stacks, winds), causes and reduction programs for specific emissions such as sulfur dioxide, particulates, and nitrogen oxides, noise, nuclear power reactors, water pollution, thermal discharges, and power station economics.

**34192** **APTIC NO. 56378**

Purcell, Arthur H.

ENVIRONATICS: THE NEXT STEP. *Inst. of Environmental Sciences, Mount Prospect, Ill., Proc. Inst. Environ. Sci., Annu. Tech. Meet., 17th, Los Angeles, Calif., 1971, p. 13-16. 4 refs. (April 26- 30.)*

The concept of Environatics, a broad, systematic, and integrated approach to environmental problems, is discussed. Environatics breaks down the causes of environmental difficulties into six semi-independent areas; an Environatical chart illustrates how these six areas, individually and in combination with one or more of the others, contribute to a polluted environment. It can be seen that without simultaneously attacking all these areas, significant pollution will remain in the environment. (Author abstract modified)

## GENERAL

### 1973

**34193** **APTIC NO. 56621**

Kowald, Kenneth

THE PUBLIC AND POLLUTION: A REVIEW AND SOME PREDICTIONS. *Proc. Int. Clean Air Congr., 3rd, Duesseldorf, West Germany, 1973, p. D67-D69.*

A review is presented of the concerns and direction of the environmental movement in the United States. Air pollution has been longest in the public consciousness and offers the best subject for analysis of the rise of the movement and its future course of action. Concern for smog and other pollutants common to urban atmospheres began to grow in the early 1960s under the direction of Senator Edmund S. Muskie who headed a subcommittee of the United States Senate s Committee on Public Works. The movement to address air pollution problems peaked around the time of Earth Day in 1970, and environmental classes were becoming a fact of life from kindergarten through university studies. The no-growth and other aspects of the environmentalists non-degradation policy was, however, being perceived by increasing numbers of minority spokesmen as a prelude to no jobs. Others began to see the environment as the totality of the world which people inhabit, and reassessments of our environmental actions began to occur. The priorities of the New York City Comprehensive Health Planning Agency, for example, listed housing first, followed by waste disposal, air pollution, and occupational health and safety as environmental problems. Thus it appears the country has reached the stage where environment is recognized as everything around us, and environmental problems are acknowledged as not being easily solved.

## 1972

**34194** **APTIC NO. 56778**

Cubitt, L. J. and J. B. Hinwood

EXPERIMENTAL PROPERTIES OF BUOYANT VORTEX RINGS. *Clean Air Society of Australia and New Zealand, Proc. Int. Clean Air Conf., Melbourne, Australia, 1972, p. 60-65. 8 refs. (May 15-18.)*

Field experiments forming large-scale vortex rings from ground- level explosions wery conducted to show that the similarity laws may be extended to consider atmospheric scale vortex rings and to examine the possibility of generation of vortex rings for economical effluent removal. The experiments revealed two possible flaws in the ideal picture of vortex ring formation. The first refers to the production of a secondary ring which travels more slowly than the primary ring and has a much shorter rise height. These secondary rings are frequently formed when vortex rings are generated by interrupting a jet or by forcibly discharging a blob of fluid. The second problem follows from the observation that if burned gases were exposed to a sufficiently strong wind during their formation the vortex ring which formed was weaker and dirtier. It appears that a properly designed shield which protects the ring during its formation could raise the limiting cross wind velocity, but there is a limit beyond which the wind will cause the ring to shed smoke to such an extent that the method is unusable in certain locations. The two difficulties revealed by the experiments do not appear to be insuperable obstacles, but they do require additional research before vortex rings can be applied to smoke disposal.

**34195** **APTIC NO. 56361**

Kwanten, F. J. G. and J. Huiskamp

GAS ABSORPTION TOWERS. PART A: GENERAL. *In: Processes for Air Pollution Control. G. Nonhebel (ed.), Cleveland, Ohio, CRC Press, 1972, Chapt. 5, p. 73-164. 7 refs.*

A review of the literature up to 1970 on the general factors basic to absorption of gases is presented. The topics covered include: diffusion; mass transfer concept; mass transfer calculation of gas absorption towers; types of tower (packed, bubble, spray); hydraulic design of packed towers; hydraulic design of plate towers; practical aspects involving construction of towers, liquid hold-up, operation and maintenance, instrumentation, safety, and economic gas velocity; and worked examples of mass-balance, hydraulic design, number of theoretical plates, plate efficiency, actual number of trays, and interfacial temperature.

**34196** **APTIC NO. 56888**

Wentzel, Karl Friedrich

DEMANDS OF NATURE PROTECTION IN AIR POLLUTION CONTROL. *(Forderungen des Umweltschutzes an die Luftreinhaltung). Text in German. Mitt. Forst. Bundesvers., no. 97:117-128, 1972. (Presented at the International Symposium of Forest Fume Damage Experts, 7th, Essen, West Germany, Sept. 7-11, 1970.)*

The preservation and conservation of the natural foundations of life has become a major issue in the modern world, with air hygiene being a social-political task of the first order of importance. Appeals, congresses, speeches, demonstrations, published research results, and new experimentation are not enough, however, The air must become cleaner. Dust pollution in the Ruhr is decreasing, but fume pollution is not. Forest damage and mortality rates are high and are not decreasing. The biological forces are not sufficient to heal the pathological side-effects of technology and chemistry. Man must do without industrial growth rates if they can be bought only by locally unacceptable air pollution or other squandering of the natural foundations of life.

## 1970

**34197** **APTIC NO. 56334**

Mathews, Dean S.

THE 1970 S: A TIME FOR TECHNOLOGICAL RESPONSIBILITY. *Preprint, Louisiana Tech Univ., Ruston, La., Continuing Engineering Education Div., p. 27-41, 1970. (Presented at the Institute on Aspects of Air Pollution Control, Ruston, La., 1970.)*

Man s recent technological activities which have resulted in pollution of the air are reviewed with particular emphasis on the role of the automobile in environmental degradation and measures being taken by the Federal Government to correct the problem. The automobile is responsible for more than half the hydrocarbons and for nearly half the nitrogen oxides discharged into the air of the United States each year; these are the principal ingredients that go into the formation of photochemical oxidant. The automobile is also responsible for three-fourths of the carbon monoxide polluting the air in this country and is the chief source of lead in the atmosphere. Moreover, it is a significant source of particulate matter in some cities. Standards presently in effect for hydrocarbons and carbon monoxide emissions will result, at best, in a 40% drop in current emissions by 1980, roughly what they were in 1953; after 1980, when these standards have passed the saturation point of their effectiveness, the levels of pollution will resume their upward climb unless further measures are taken. Some additional steps being considered for control of automotive pollution are: production of less polluting fuel, development of gas turbine, steam engine, or electric automobiles, and a revival of mass transportation.

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